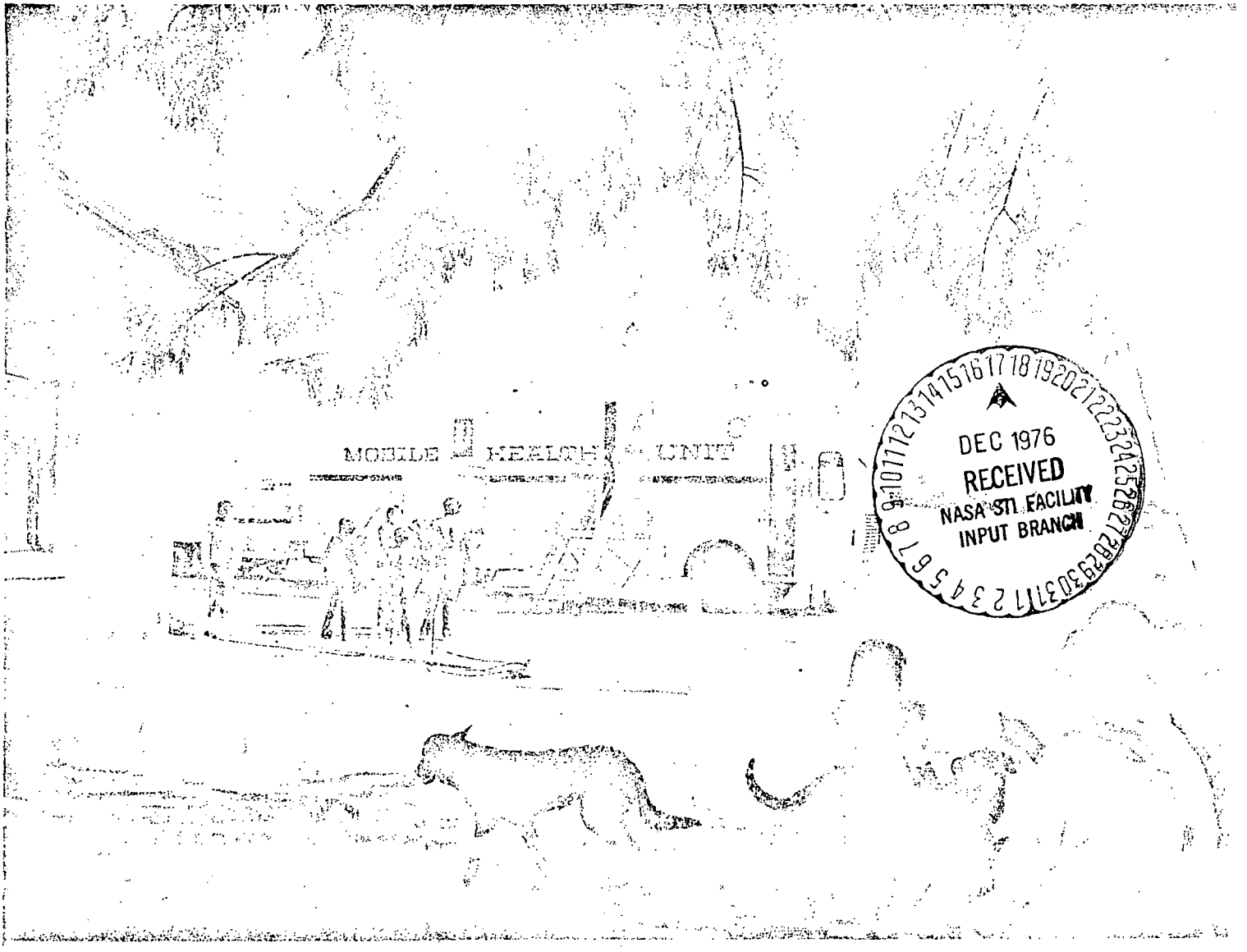
LMSC-D500704
15 JUNE 1976

STARPAHC INTERIM EVALUATION REPORT

May 1975 Through April 1976



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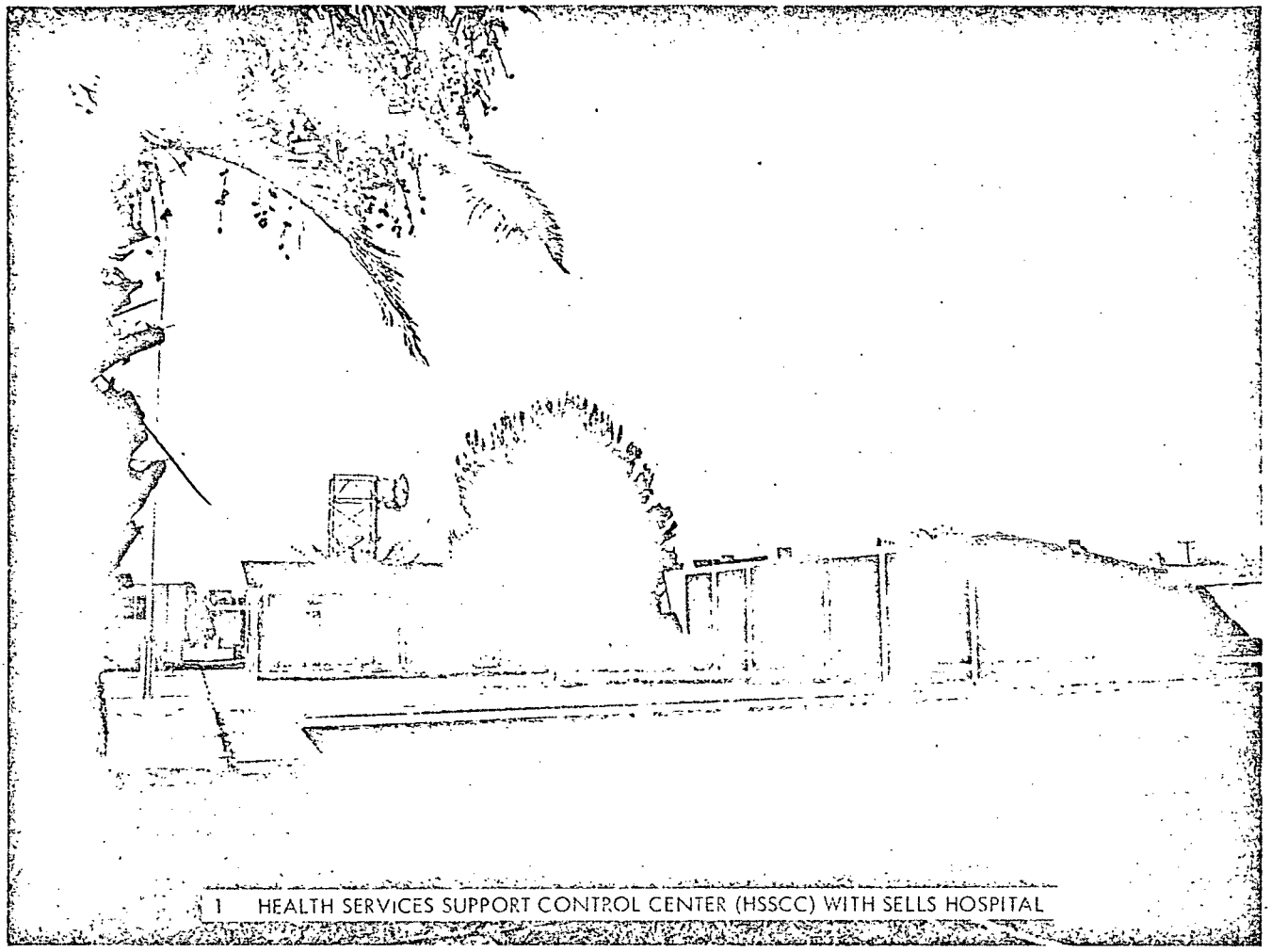

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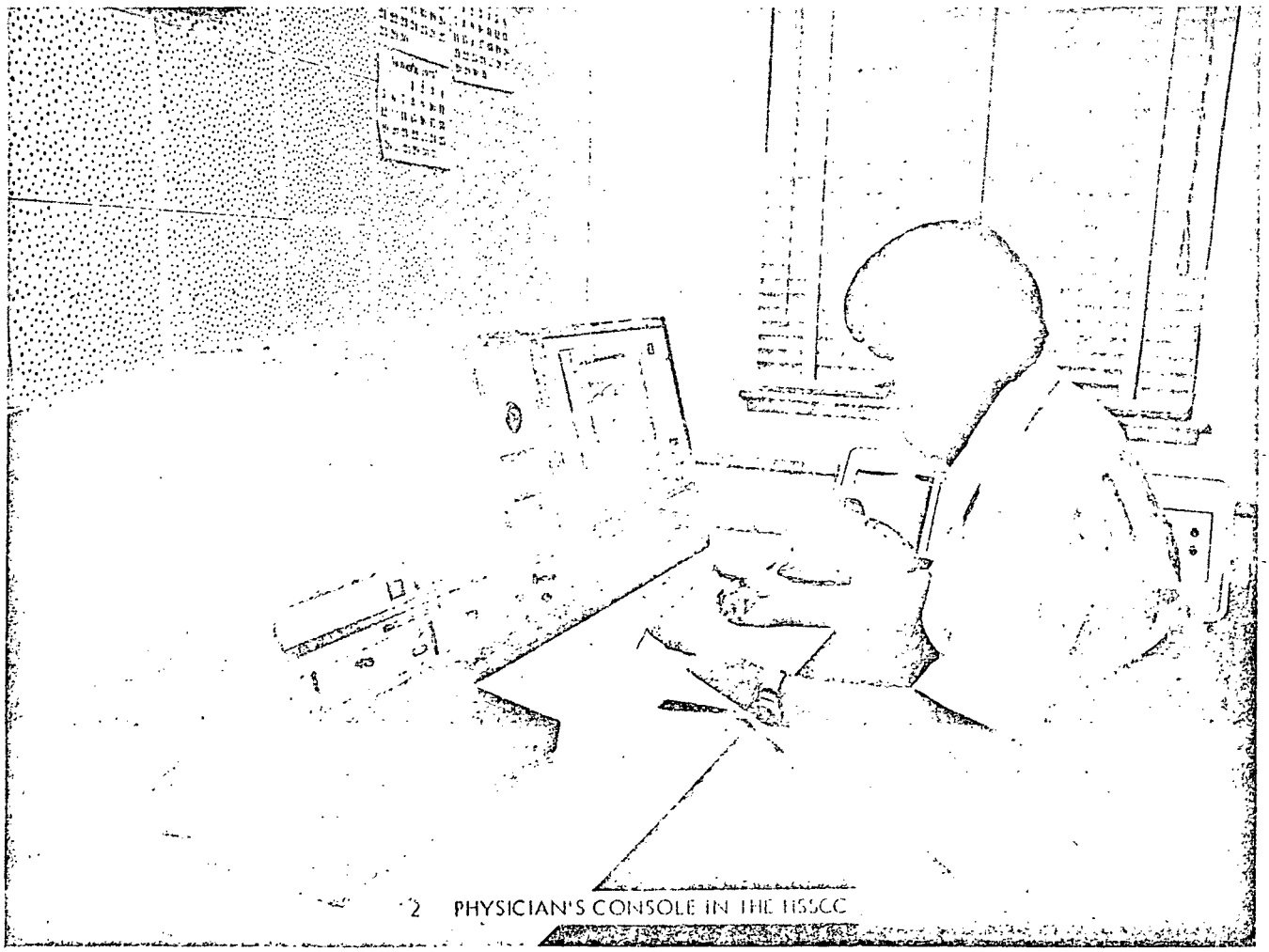

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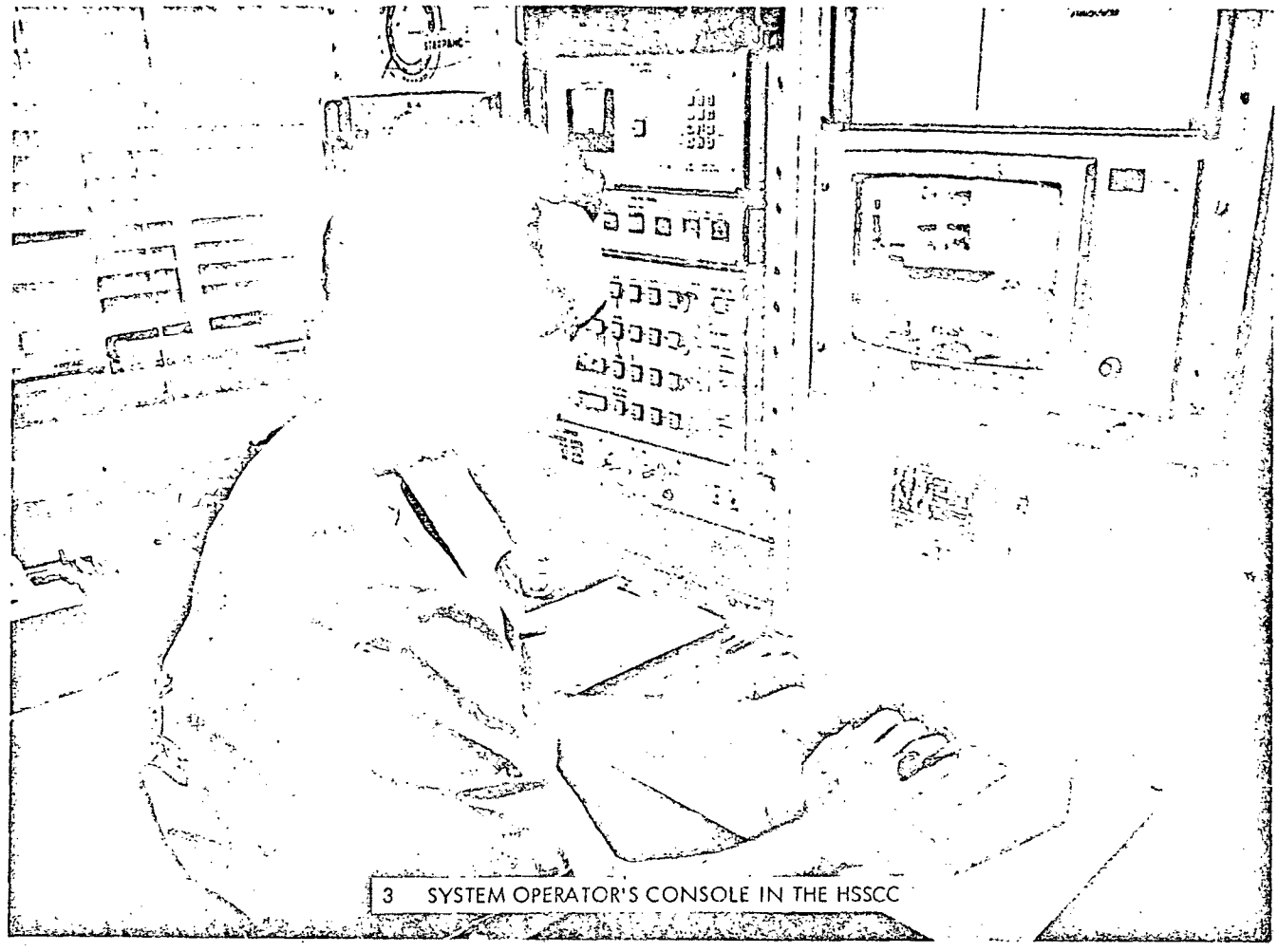
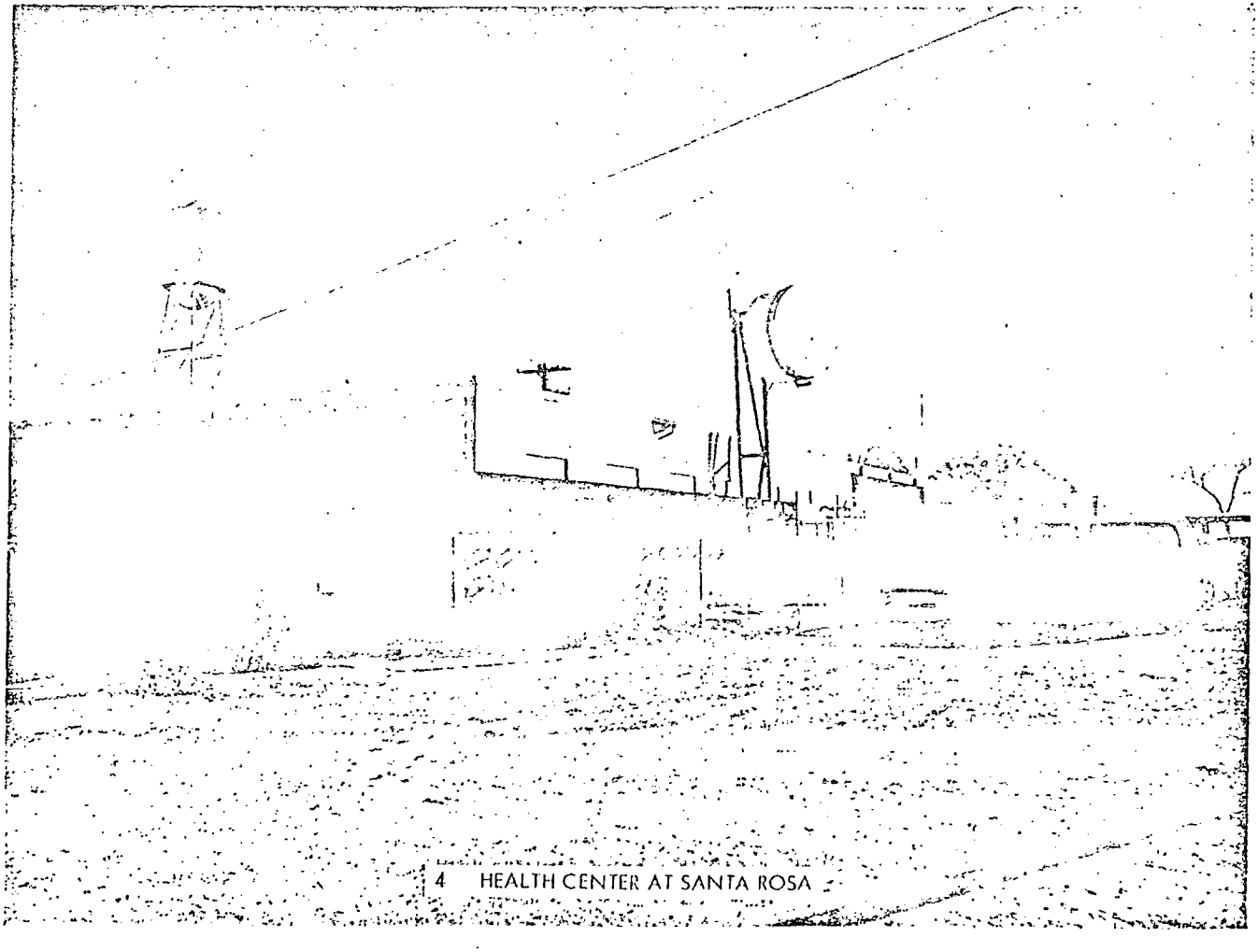
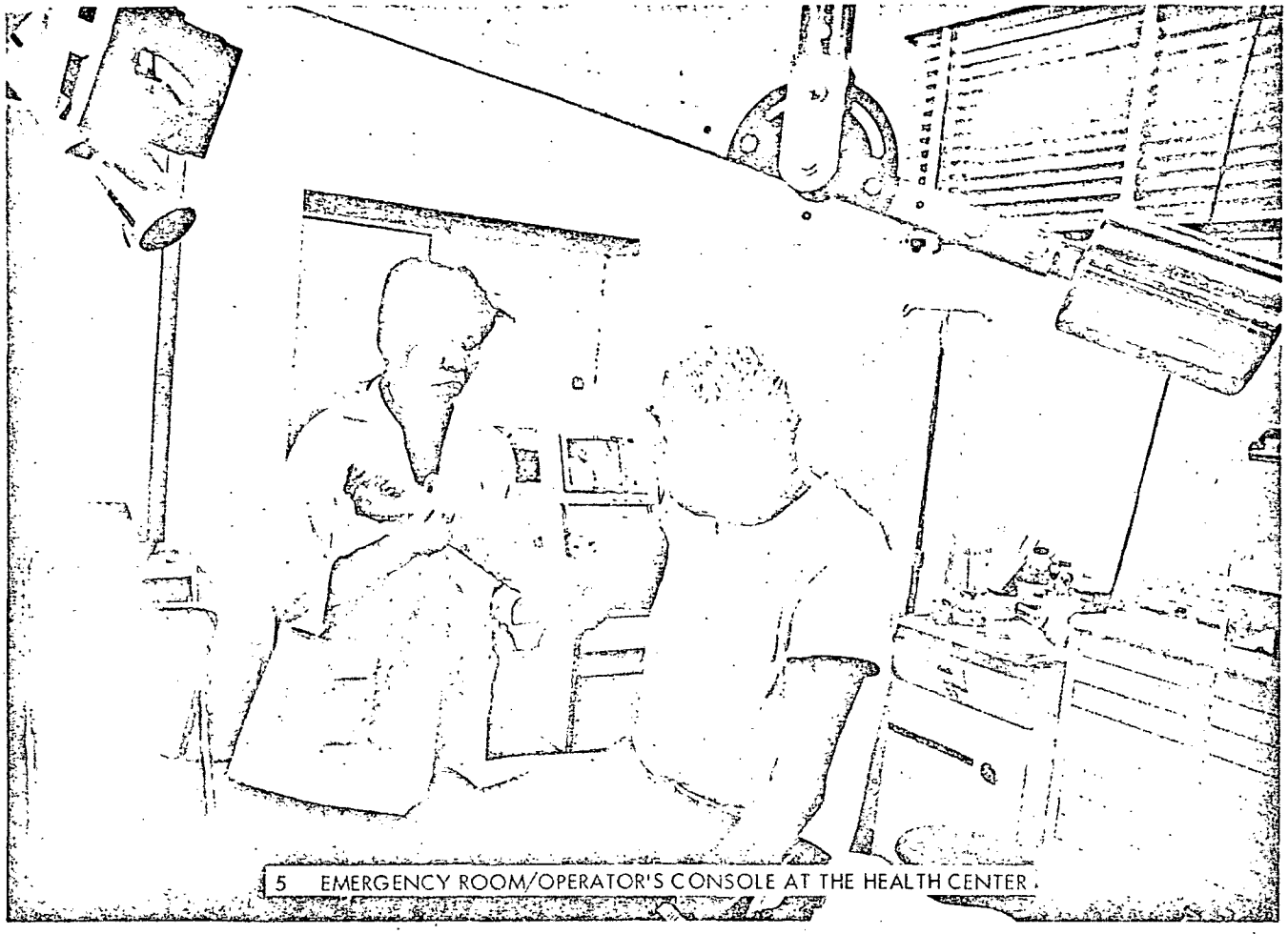


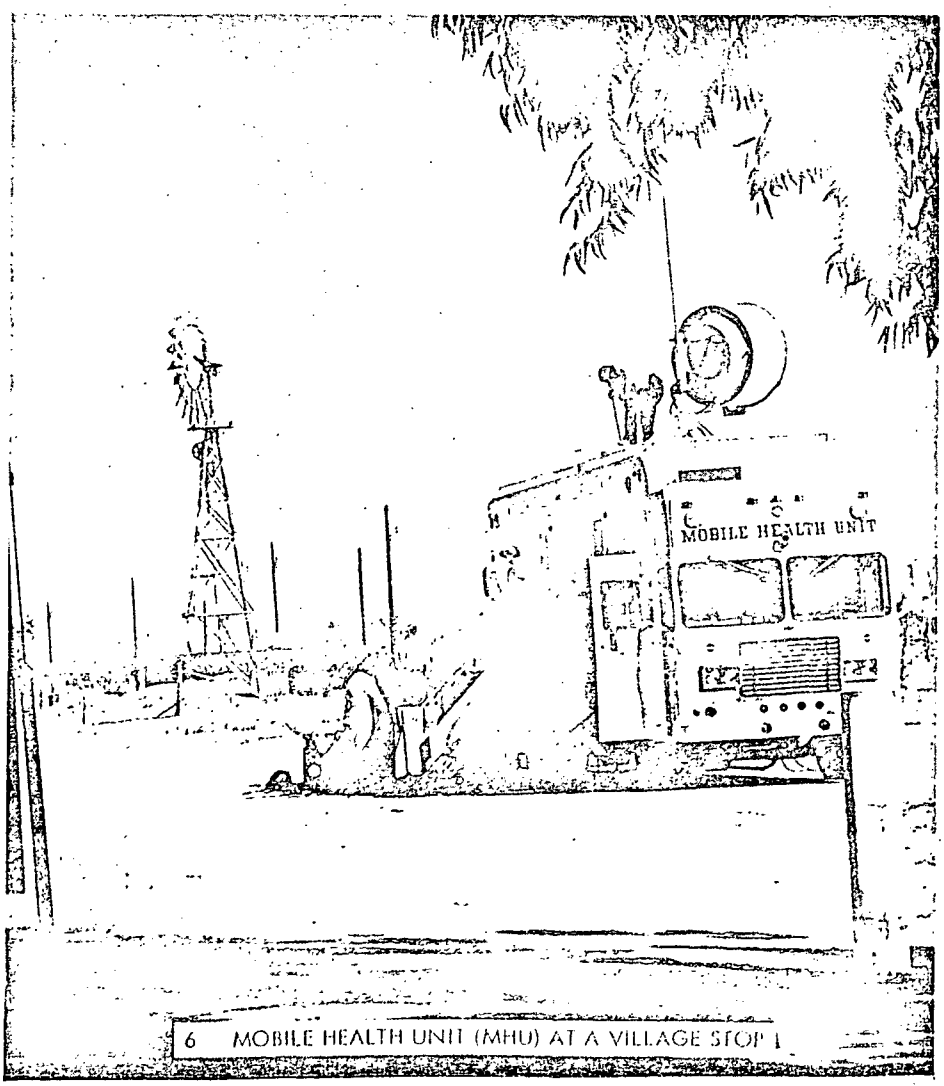
3 SYSTEM OPERATOR'S CONSOLE IN THE HSSCC



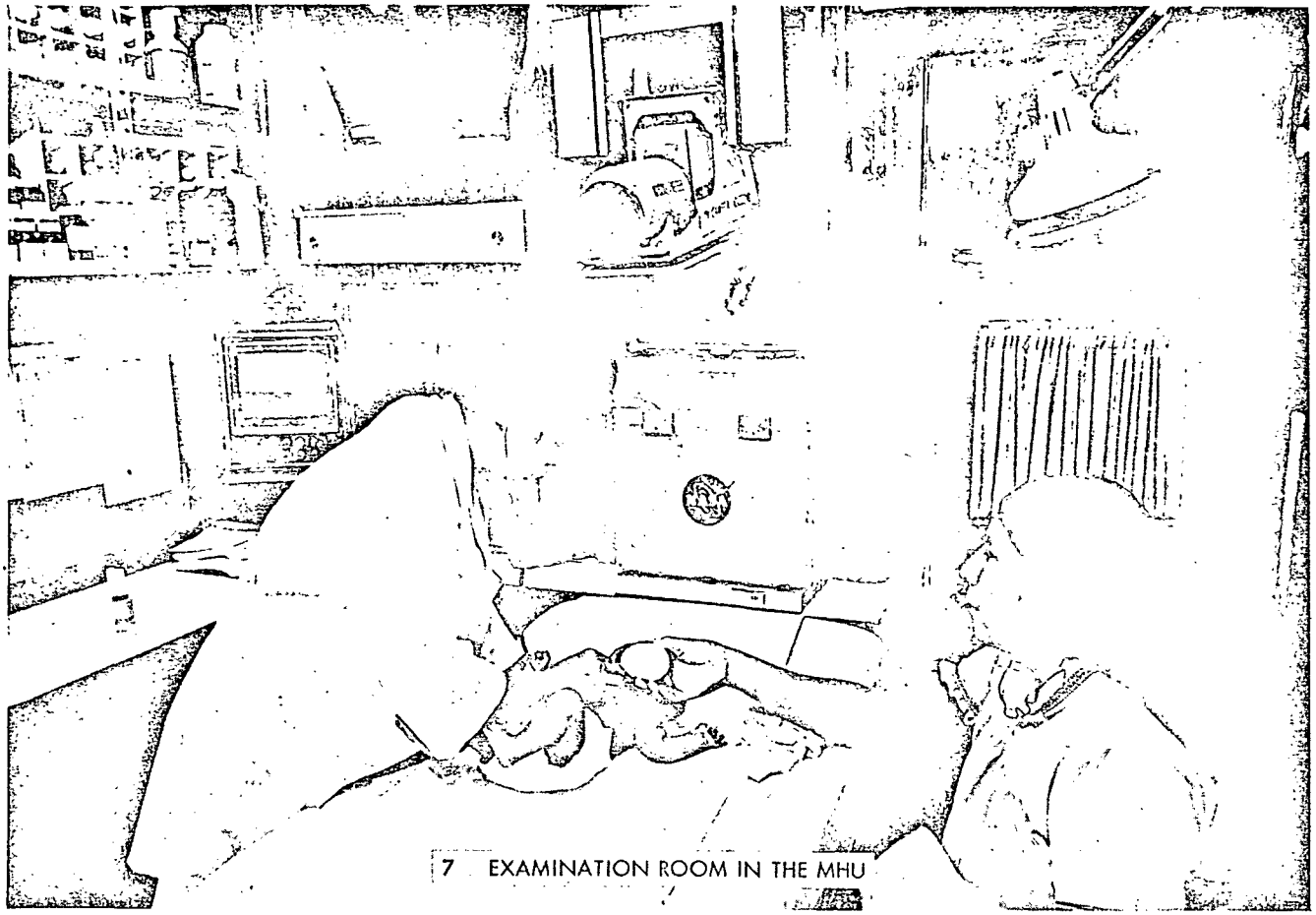
4 HEALTH CENTER AT SANTA ROSA



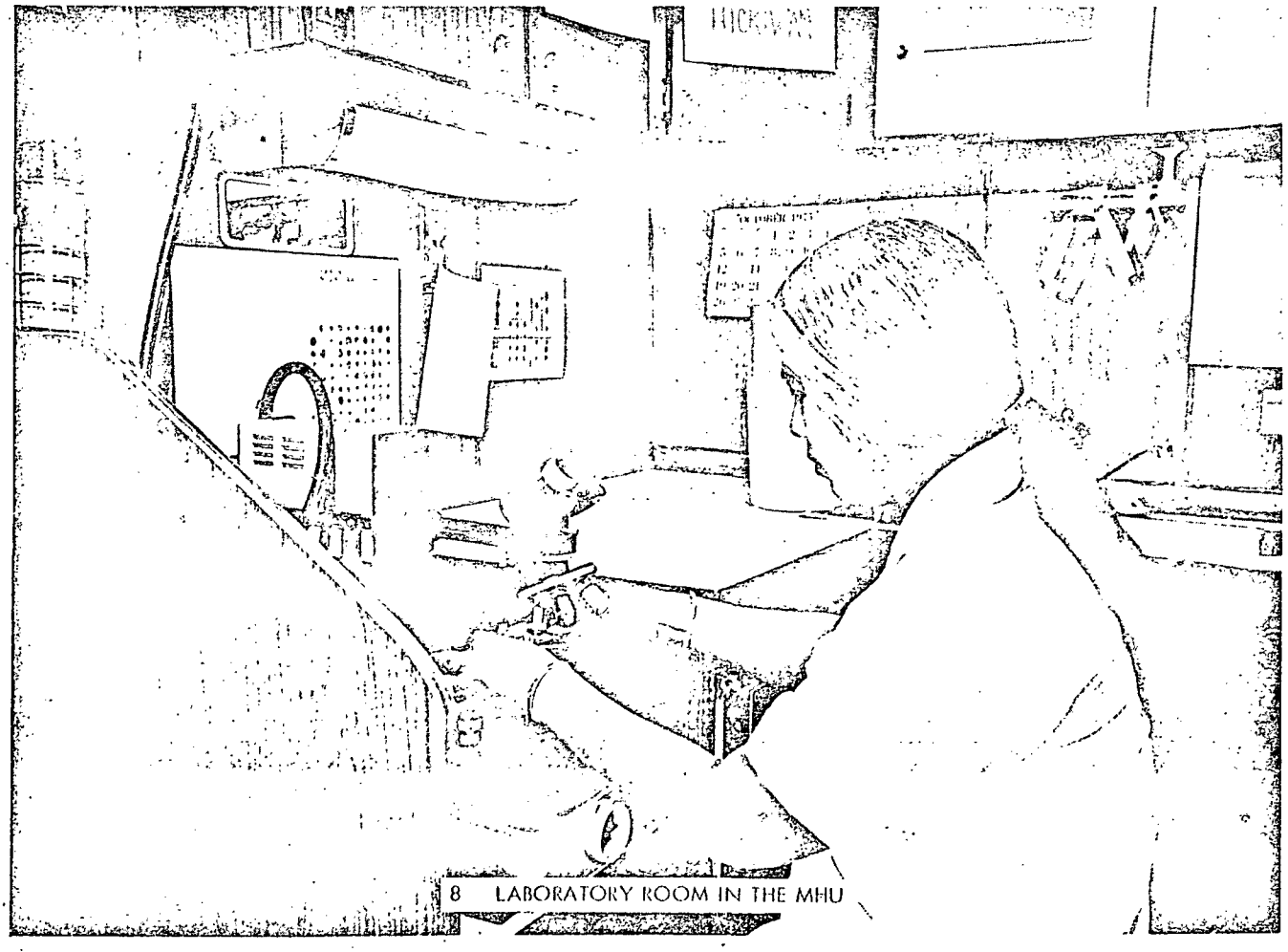
5 EMERGENCY ROOM/OPERATOR'S CONSOLE AT THE HEALTH CENTER



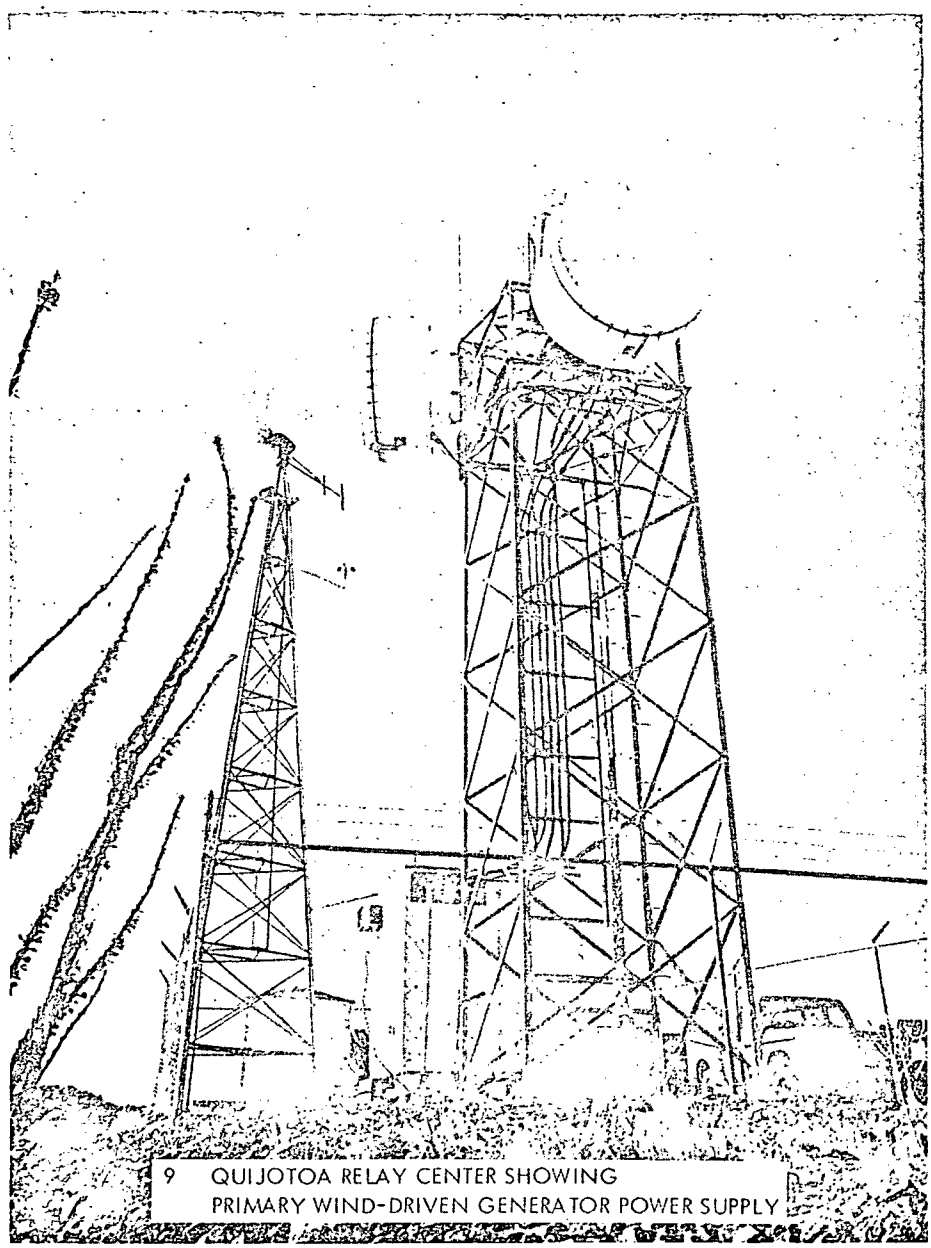
6 MOBILE HEALTH UNIT (MHU) AT A VILLAGE STOP



7 EXAMINATION ROOM IN THE MHU

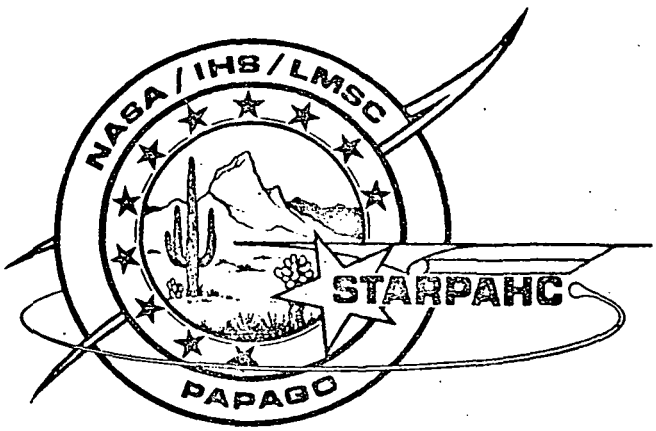


8 LABORATORY ROOM IN THE MHU



9 QUIJOTOA RELAY CENTER SHOWING
PRIMARY WIND-DRIVEN GENERATOR POWER SUPPLY

LMSC-D500704
15 June 1976



STARPAHC INTERIM EVALUATION REPORT

(FIRST YEAR OPERATION)

Period: May 1975 Through April 1976

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FOREWORD

Lockheed Missiles & Space Company, Inc. (LMSC) submits this STARPAHC Interim Evaluation Report in compliance with Contract NAS 9-13170 dated 15 December 1972, covering evaluation of the first year of operations.

This program for Space Technology Applied to Rural Papago Advanced Health Care (STARPAHC) is being conducted under the auspices of the NASA (Johnson Space Center), Norman Belasco, Project Officer, working in conjunction with DHEW (IHS-ORD), Stuart Rabeau, M.D., Director, and the Papago Indian Nation, Cecil Williams, Chairman, Tribal Council. The LMSC STARPAHC team is under the direction of James M. Smith, Program Manager, assisted by F. E. Riley.

The STARPAHC system (description in Appendix C) is being evaluated over a 2-year operational period. Evaluation of the medical aspect is being conducted by IHS under the direction of James W. Justice, M.D., and evaluation of the hardware aspect is being conducted by LMSC. At the completion of the 2-year period, the results of these evaluations will be synthesized into a systems performance evaluation report.

This report summarizes the results of the first year of operation with emphasis on comparisons between the first and second semi-annual reporting periods. An operational cost summary analysis also is presented.

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ILLUSTRATIONS

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TABLES

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GLOSSARY OF ABBREVIATIONS

A/N CRT	Alpha/Numeric Cathode Ray Tube
APU	Auxiliary Power Unit
B&W	Black and White
baud	Unit of Signaling Speed
BIA	Bureau of Indian Affairs
CHR	Community Health Representative
CHM	Community Health Medic
CRT	Cathode Ray Tube
CPU	Central Processing Unit
DHEW	Department of Health, Education, and Welfare
ECG	Electrocardiogram
FCC	Federal Communications Commission
FD or FDX	Full Duplex
HIS	Health Information System
HRA	Health Resources Administration
HSA	Health Services Administration
HSSCC	Health Services Support Control Center
Hz	Hertz (cycles per second)
I.D.	Identification - LMSC Employee Number or IHS Medical Record Number
IHS	Indian Health Service
IMBLMS	Integrated Medical and Behavioral Laboratory Measurement System
I/O	Input/Output Terminals
IPO	IMBLMS Program Office
JSC	Johnson Space Center
KVA	Kilovolt-Amperes
LHSC	Local Health Services Center
LMSC	Lockheed Missiles & Space Co., Inc.
LVN	Licensed Vocational Nurse
MHU	Mobile Health Unit

GLOSSARY OF ABBREVIATIONS
(Continued)

MHW	Mental Health Worker
MHz	Megahertz (million cycles per second)
MUX	Audio Multiplexer Unit
NASA	National Aeronautics and Space Administration
NASA-MEDICS	NASA Medical Information Computer System
PAM	Portable Ambulance Module (Telecare Unit manufactured by SCI Electronics, Houston, Texas)
PAR	Performance Acceptability Ratio $\text{Gross PAR} = \left(1 - \frac{\text{Failures}}{\text{Telecommunications}}\right) 100 = \%$ $\text{Net PAR} = \left(1 - \frac{\text{Anomalies (Fair, Poor, Failures)}}{\text{Telecommunications}}\right) 100 = \%$
PHN	Public Health Nurse
PHS	Public Health Service
PIMC	Phoenix Indian Medical Center
PRC	Phoenix Referral Center (STARPAHC terminal equipment located in Phoenix Indian Medical Center)
QRS	Quijotoa Relay Station
R&DD	Research and Development Division (of LMSC)
rf	Radio Frequency
STARPAHC	Space Technology Applied to Rural Papago Advanced Health Care
TCC	Tucson Computer Center
TCE	Telecommunication Equipment
TTY	Teletypewriter
UPS	Uninterruptible Power System
vhf	Very High Frequency (STARPAHC 170-MHz Band)
VTR	Video Tape Recorder
WDG	Wind-Driven Generator

GLOSSARY OF COMPUTER TERMS

ACMED	A MEDICS application program whose function is to provide reports of medications due for inpatients in the Sells Hospital. This program uses the Active Medications Data Base, and is used primarily by the Nurses at the Nurses Station.
ACTIVE MEDICATIONS DATA BASE	This data base is a collection of data regarding the medications ordered by the attending physician for inpatients at the Sells Hospital. In general, this data includes hours due, medication, dosage, physician's name, patient name, and room number. This data base is primarily used by the ACMED and MEDS programs.
BSC	Binary Synchronous Communication. The Data Concentrator uses this discipline when transferring data from the Indian Health Service Computer in Tucson.
CDI HARDCOPY	This is the terminal that communicates with the computer. There is a keyboard where alphabetical or numeric characters can be sent to the computer. Messages from the computer are typed out on paper (hard copy). CDI is the name of the vendor.
DATA BASES	An organized collection of data. Organization of each data base is directly related to the data to be stored; i.e., numeric data is filed in numeric order, time related data is filed chronologically, or alphabetic data such as patient names, is filed alphabetically. The MEDICS data bases can be accessed by several application programs. Users use these programs to store, report, or change data in the data bases.
DATA CONCENTRATOR	The Data Concentrator is a software program that compacts data to be sent to the Indian Health Service Computer in Tucson. Another function of the Data Concentrator is to unpack compacted data from the computer in Tucson and transfer it to the terminal. The program also maintains the BSC line discipline for the outgoing and incoming messages.
DIAL-UPS	Four telephone lines are available to the user to dial the STARPAHC computer for access of data. The user can dial the computer and place the telephone headset into his terminal. He then can request patient summaries from the Tucson computer or any of the data bases maintained in the STARPAHC computer.
DISEASE LIBRARY	This data base is a collection of reports used by the paramedics and nurses. The Guidelines of Care reports are used by the paramedics to guide them in diagnosing diseases. The Nurses Standards reports are used by the nurses to remind them of tasks needed to be accomplished in their care of the patient. These reports are filed by Disease Name.

EQUIPMENT RECORDS DATA BASE	This data base is used to collect data regarding the STARPAHC equipment. Preventive maintenance schedules and procedures along with Trouble Reports and Usage Reports are maintained in this data base.
FOLLOW-UP CLERK TEC CRT	This terminal resides in the Follow-Up Clerk's office at Sells Hospital. The main function of this terminal is to schedule outpatients for the Specialty Clinics. The terminal is a CRT (TV set) with a keyboard for sending alphabetic or numeric characters to the computer. Messages from the computer are flashed on the TV screen (CRT). TEC is the vendor name.
GE HARDCOPY	This terminal is used to communicate with the computer. It has a keyboard for sending alphabetical and numerical data to the computer. The computer types out messages on paper (hard copy).
GUIDE	This is a MEDICS application program that types out the Guidelines of Care reports to the user. These reports are used by the paramedics to guide them in diagnosing diseases. There are five reports available now. All reports are designed by the Indian Health Service.
HAZELTINE CRT	This is the terminal located at the Nurse's Station. This terminal is used for accessing the Active Medications reports and the Nurse's Standards. This terminal has a CRT (TV screen) and a keyboard for sending alphabetical or numerical characters to the computer. The computer flashes messages on the CRT screen. Hazeltine is the vendor name.
HIS	Health Information System. This is the name of the computer in Tucson that maintains the Indian Health Service patient summaries.
IMS	This is a MEDICS application program that summaries patient exam data. This program utilizes the Outpatient Records data bases.
INFOTON	This is a terminal with a CRT (TV screen) and a keyboard for sending alphabetic and numeric data to the computer. The computer sends messages to the CRT screen. There is an Infoton (vendor name) in the LHSC as well as the Pharmacy.
INPATIENT RECORDS DATA BASE	This data base is a collection of hospital census information, such as admissions, discharges, and disposition in case of fatality.
INPUTP	This is a MEDICS application program used in storing data into any one of the various data bases. The program uses a question/answer technique where the questions are related to the data base and the answers are typed in (by keyboard) by the user and stored by the program.

MEDS	This MEDICS application program is used to store data exclusively into the Active Medications Data Base. The program is identical to the INPUTP program in structure, but differs in the amount of data stored. Upon completion of a question/answer session, the program interrogates the answers to store multiple data into the data base. If a user stores for ten days, a certain hour that a patient is to receive medication, ten sets of the data are stored - one for each day at the given hour.
MEDICS APPLICATION PROGRAMS	These are programs that are designed to interact with a user at his terminal. They store, manipulate, or report data from the data bases to the user or from the user to the data bases. These programs constitute a major portion of the computer usage.
NURSE	This MEDICS application program is used to report Nurses Standards to a terminal. The program utilizes the Disease Library Data Base.
OUTPATIENT RECORDS DATA BASE	This data base is a collection of patient exam data such as blood pressure, pulse, temperature, weight. This data base is used primarily by the IMS program.
PHARMACY DATA BASE	This data base is a collection of patient data regarding medications for outpatients. This data base is used primarily by the Pharmacy at Sells Hospital.
PHY/OPS TEC CRT	This is a terminal that communicates with the computer. There is a keyboard for sending alphabetical or numerical characters. The computer flashes messages on the CRT (TV screen). TEC is the vendor name. This terminal is located at the Physician's Console and the Operator's Console.
RETRVL	This MEDICS application program reports data to the user at the terminal. The user can request tabulations, lists, etc., to define the report. Any data base can be used by this program.
SCHEDULE DATA BASE	This data base is a collection of patient data regarding scheduling patients for the specialty clinics. This data base is primarily used by the Schedule program.
SCHEDULE	This MEDICS application program generates schedules based on data found in the Schedule Data Base. The user can request a schedule for any clinic in the system and for any day.
STAT3	This software program provides daily statistics of the computer usage giving user name, program(s) used, data base used, etc. This program reports these statistics at 5:00 each afternoon.

STAT4	This software program summarizes the total daily statistics contained in the computer file. This program is usually executed weekly, summarizing the week's computer usage. Data reported is the same as STAT3.
STATS	This MEDICS application program reports statistical data to the terminal; it provides the number of users in the system and the terminals being used. This program is available to the user at the terminal.
TERMINALS	These are devices especially designed to communicate with the computer. A terminal can be a CRT (TV screen) or hard copy (paper) and always has a keyboard for sending alphabetic or numeric characters to the computer. Using a terminal, a user can store data, retrieve a report of data on the computer, or change data in the computer.
TESPAT	This MEDICS application program types a test pattern onto the screen (in the case of CRT's) or on paper (in the case of hard copy). This program is used for check-out purposes only.
TI HARDCOPY	This terminal resides in the MHU Reception area and is used to access data from the Indian Health Service computer in Tucson as well as the STARPAHC computer. Alphabetic or numeric characters are sent to the computer using a keyboard. Messages from the computer are typed out on paper (hard copy). TI is the vendor name.
UPDATE	This MEDICS application program allows a user at the terminal to change or delete any data in any of the data bases.
USERS	This term defines the person(s) who access the computer system. To access any data in the system, a user must tell the computer his access code, by typing the access code on his keyboard. This access code is used to define who the user is and the data bases he may access.

SUMMARY

The primary goals of the STARPAHC Program are to:

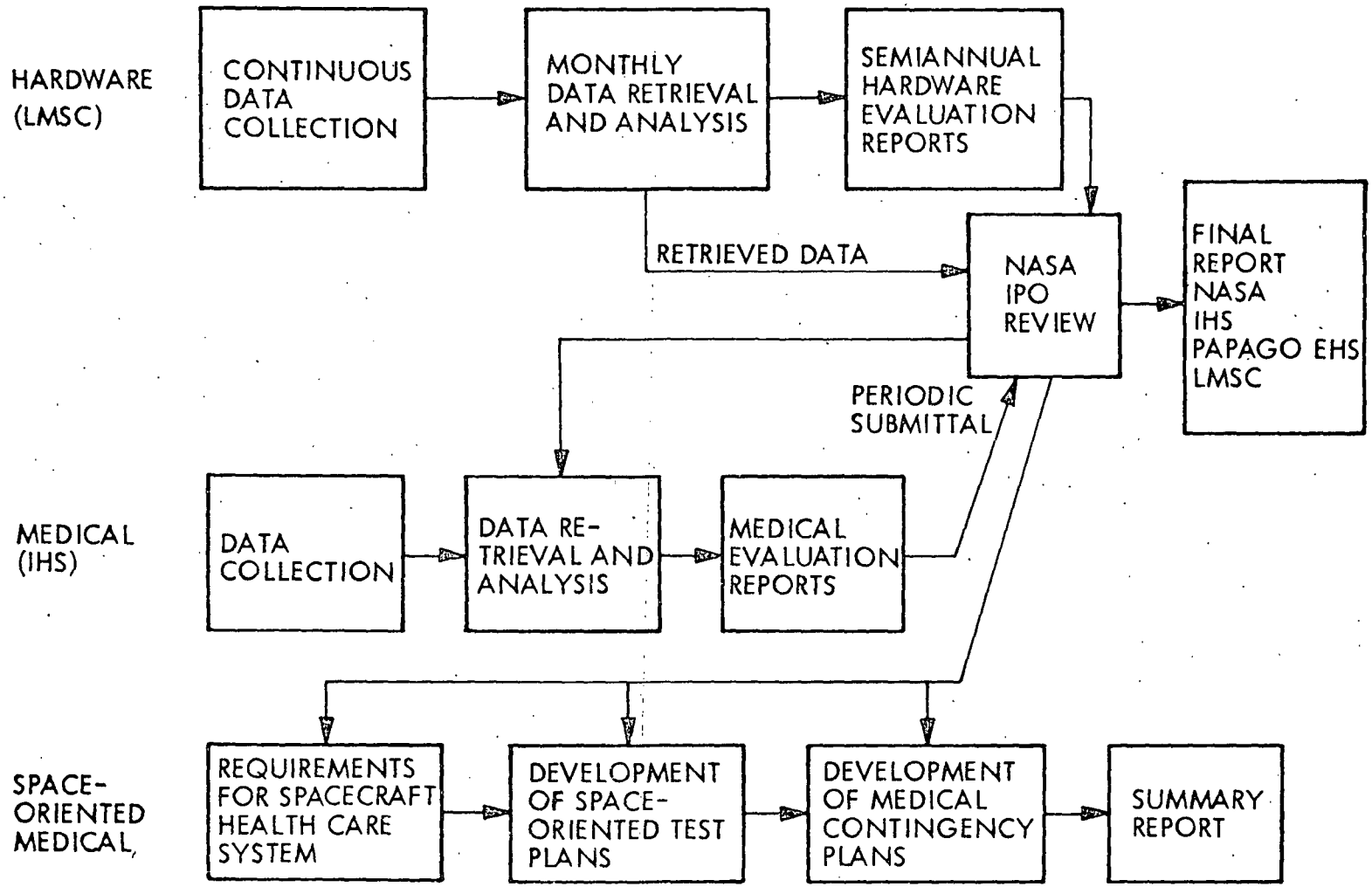
- Provide data for developing health care for future manned spacecraft,
- Establish the feasibility of the STARPAHC concept (see Appendix B) for improving the delivery of health care to remote areas on earth.

Accordingly, the hardware and medical evaluations initiated during the first 6 months of system operation have been continued and expanded during the second 6-month period. The evaluations are based on what has proven to be a relatively stabilized 6-month period wherein system failures which occurred during the initial shakedown period in the first 6 months have been minimized. Early trends and performance data reported in the first semi-annual report have been reexamined to either verify, modify or change earlier conclusions.

The contents of this report present the highlights of the total year of operation with emphasis on comparisons between the first and second semi-annual reporting period. In addition, an early analysis of costs is summarized.

EVALUATION APPROACH — In the system evaluation, page xviii illustrates the evaluation goals and processes. As noted in the figure, monthly data retrievals are summarized in the form of a semi-annual evaluation report (submitted to NASA for review). The hardware and medical data have been coordinated between LMSC and IHS personnel and have been integrated in this report. Cost data reflect inputs from both organizations. The next semi-annual reports are scheduled for November 1976 and at the completion of the 2-year operational period, May 1977.

For achieving the hardware evaluation objectives, a method was established to (1) acquire field data by daily data collection in manual records by the site personnel; (2) incorporate the data into computer-based logs; (3) reduce, analyze, interpret, and compare the raw data to obtain specific answers to satisfy the stated objectives; and (4) perform a calibration program which affords an insight into any performance change in the video/audio links of the system.



Evaluation Information Reporting

For achieving the medical evaluation objectives, a method was established to (1) document field activities; (2) interview the health staff, the patients, and community residents; (3) provide special evaluation forms to be completed by the health providers; (4) review and analyze the computer printout for telecommunication data; and (5) perform a detail cost analysis of the health care system correlated with a hardware cost study.

There are 3 independent investigations conducted by IHS and by NASA supplement the medical evaluation: (1) quality of care analysis for certain specific diagnostic categories; (2) study of the history of the planning, development, and implementation of the STARPAHC Project by the University of Michigan; and (3) NASA is conducting a space-oriented Medical Verification through a contract with the Boeing Company. Results of these studies will be reported separately and independently of STARPAHC.

HIGHLIGHTS Following are highlights of this report period:

- o Telecommunication equipment usage increasing.
- o Community acceptance exceptional.
- o Total utilization of health services decidedly increased.
- o Proportionally more patients seen by providers other than physicians.
- o Visits to hospital MDs slightly increased.
- o Visits to CHMs at MHU increased; slightly less at the fixed clinic.
- o Patient load on MHU plateaued at maximum capacity.
- o MHU missed only one day of scheduled service.
- o Slo-scan operation between Sells/Phoenix proven successful.
- o Early evaluation data indicate STARPAHC proven feasible.
- o System operation continued successfully through the reporting period of April 30, 1976.
- o High acceptance of the Mobile Health Unit (MHU) by the Papago Indians indicated by survey and continued increase in the number of patients treated.
- o Repairs to the MHU, computer software/hardware, and improvement in power supply at Sells and Quijotoa reduced trouble reports and effected improvements in maintenance and logistic support.

- Out of the 2022 telecommunications during the November-April period, there were 33 failures, resulting in a 98.4-percent Performance Acceptability Ratio (PAR).
- Monthly average of 337 telecommunications demonstrated a stable position.
- Medical use of the telecommunication equipment (TCE) has increased 28.4 percent over the first 6-month period.
- Feasibility of using a Wind Generator as a primary power source for the Quijotoa Relay Station has been demonstrated.

FUTURE EVALUATION

The information in this report is a summary of the first year of operation and will be a data baseline for comparison with future 6-month data. Trends are continually analyzed for early corrective actions. A low or high equipment rate usage can be determined easily and reasons for their increase or decrease can be established. (A weekly highlight summary has been established for this express purpose.)

Section 1
SYSTEM USAGE

1.1 HARDWARE EVALUATION APPROACH

The Hardware Evaluation Plan (Appendix B) has been implemented during both the first and second 6-month period to achieve three goals:

- o STARPAHC Improvement
- o Exportability *
- o Acquisition of Space System Design Data

Figure 1-1 illustrates the hardware evaluation approach. Acquisition of field data is accomplished through the individual site personnel daily records (system operator - telecommunications records, computer operator - software/hardware, maintenance technician - daily maintenance/logistic records, site manager - summary records and IHS daily operation records). Data from these records are entered into four computer-based or manual logs. These log entries are periodically cross-checked and correlated with the IHS medical evaluation data compilations.

Raw data in each of the four computer-based logs are reduced to a summary print-out giving pertinent data as indicated in Fig. 1-1. Next, the reduced raw data are subjected to an analytical process that yields products such as arithmetical ratio, usage trends, performance acceptability ratios, cost effectiveness, transmission usage time, monthly comparison, and frequency/distribution of equipment usage.

Usage data on subsystem equipment other than Telecommunication Equipment (TCE), e.g., Quijotoa Relay Station (QRS) equipment, MHU vehicle and supporting equipment, computer and peripheral support equipment, and power equipment are collected from the maintenance technician's daily records and from the MHU user's daily operational notes.

* Potential for use in other areas.

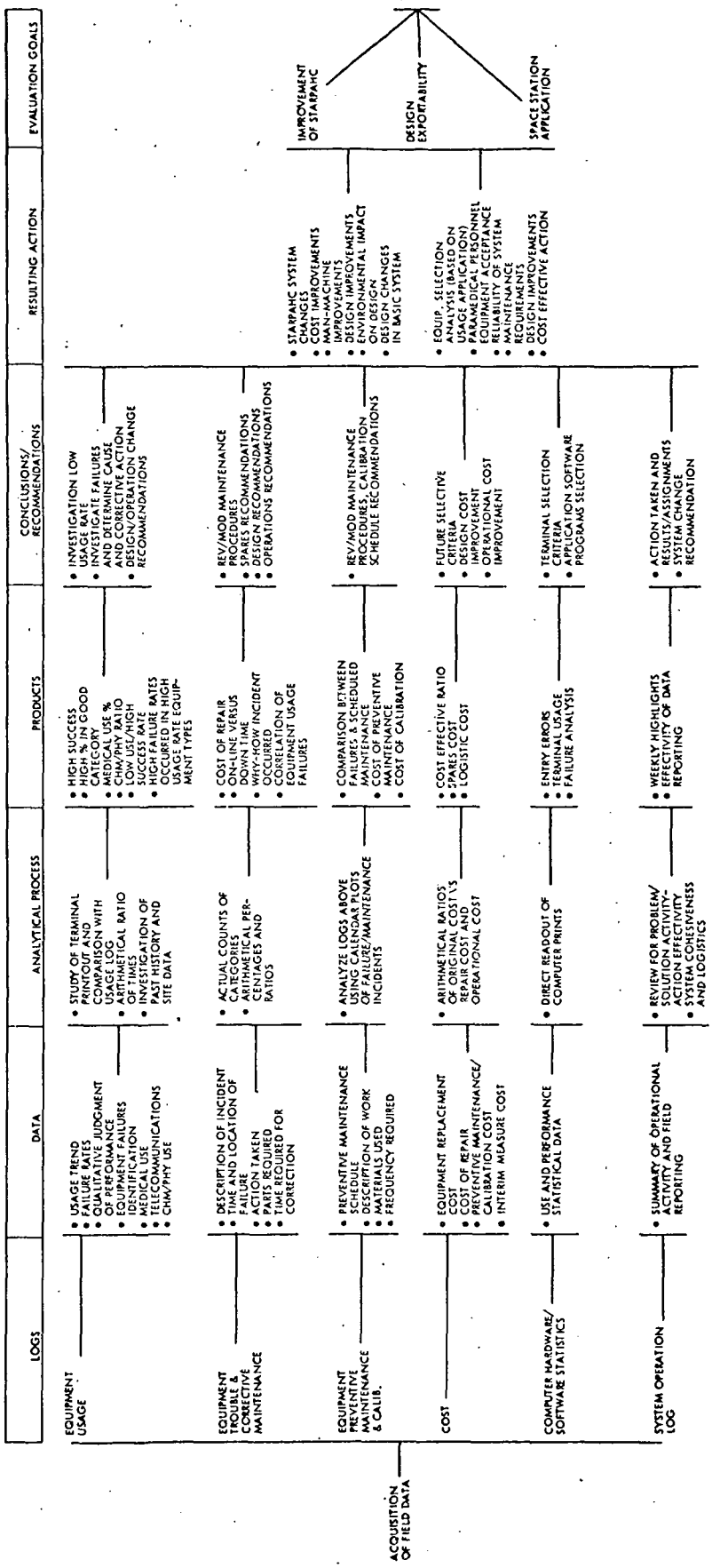


Fig. 1-1 Hardware Evaluation Approach

1.2 TELECOMMUNICATION EQUIPMENT (TCE) USAGE

The cumulative total TCE usage one-year box score for all TCE types is shown in Table 1-1, which lists the use, quality, and purpose of the equipment. Failures occur when, in the judgment of the system operator and/or the health care personnel, the transmission is not acceptable. A quality rating ranging from Excellent to Failure is used in the evaluation process. Accuracy of quality of transmission (for evaluation purposes) always assumes a good or excellent rating. Ratings of Fair, Poor, or Failure constitute an anomaly and are isolated for detail analysis.

Table 1-1 shows that there was a slight increase (2%) in the number of telecommunications during the second 6-months over the preceding 6-month period. Failures were reduced by 23.3 percent during the second 6 months, while the quality of transmissions remained fairly stable with approximately 89 percent in the Good quality for each period. The most significant differences between the two 6-month periods are reflected in the Performance Acceptability Ratio (PAR) for Medical Use. The second 6 months show a 12.5 percent increase over the first 6 months. This is attributed primarily to the increase in the number of telecommunications between the Medical Personnel and Administration during the second 6-month period compared to the first 6 months (218). Gross and Net PARs show relatively little change over the two 6-month periods.

1.3 QRS USAGE

The QRS equipment operates Monday through Saturday. The power supply configuration consists of a wind-driven generator as primary power with a 6-kilowatt diesel generator used as backup. A 2.5-kilowatt propane generator is available for switch-over in an emergency. The diesel generator has a 300-gallon tank and an auto-control circuit.

QRS has fixed antennas for communication with Santa Rosa and Sells and a rotatable antenna which is directed to the MHU. The rotatable antenna operated 125 days out of 130 days needed.

Table 1-1

COMPARISON TCE USAGE BOX SCORE

Period: 01 May Thru 31 October 1975
and
01 November Thru 30 April 1976

	Use		Quality						Purpose				
Equipment Type	Telecom	Failures	Exc	Good	Fair	Poor	Failures	C/O	Trbl Shoot	Comm	Cont	CHM/ Phy	MED/ Adm
ALL STARPAHC (1st 6 months)	1976	43	33	1764	95	41	43	177	26	611	194	473	495
												(968)	
ALL STARPAHC (2nd 6 months)	2022	33	3	1793	149	44	33	121	12	458	188	530	713
												(1243)	
Annual Totals	3998	76	36	3557	244	85	76	298	38	1069	382	1003	1208
												(2211) Medical Use	

Performance Acceptability Ratio (PAR)	1st 6 Months (Percent)	2nd 6 Months (Percent)	One Year Operation (Percent)
o Gross PAR = $(1 - \frac{\text{Failures}}{\text{Telecommunications}})\ 100 = \%$	97.82	98.37	98.10
o Net PAR = $(1 - \frac{\text{Anomalies (Fair, Poor, Failures)}}{\text{Telecommunications}})100 = \%$	90.94	88.82	89.87
o Medical Use = $\frac{\text{Medical Purpose (CHM/PHY \& MED/ADM)}}{\text{Telecommunications}}$	48.99	61.47	55.30
o Teleconsultation Use = $\frac{\text{Teleconsultation Contacts (CHM/PHY)}}{\text{Telecommunications}}$	23.94	26.21	25.09

Usage of the QRS wideband video link was considerably improved by adding a tuneable transmitter to our spares inventory to quickly handle transmitter failures at all locations. There were three transmitter failures which only interrupted TV transmissions for a total of 4 hours during the second 6-month period.

The Bramco Decoder/Encoder installation between Sells and the QRS was completed and checked out during January. This installation provides additional telemetry capability at the Quijotoa Relay Station in order to:

- Produce a time-line record to verify which QRS power source was on-line at all times
- Record the total operating time of each engine generator for predicting the need for refueling trips by the site personnel.

(This installation alerted the Sells personnel to the WDG failure).

1.4 MHU USAGE

The MHU was in continuous use (4 days a week) during the second 6-month operational period except for 1 day because of a road problem. A total of 15,000 miles were covered during the second 6-month operational period; a total of 624 hours were spent in actual health care delivery service and 104 hours were used in transit. Total of 24,400 miles were covered during the one year period and 210 hours were used in transit.

The utility power drops at Pisinimo and Kerwo were completed in December; they provide back-up power source capability at these respective MHU stops in cases of auxiliary generator failure.

Three Not Acceptable color transmissions were reported from the MHU in December. The supplier identified a defect in the camera power supply and authorized recall of the equipment which is under warranty for factory modification.

1.5 COMPUTER AND PERIPHERAL EQUIPMENT USAGE

A summary (as of 30 April 1976) of the computer usage during the one-year period showed the following:

- o Total operation time - 2252 hours
- o Total operation down-time - 250 hours
- o Percent operational down-time - 11.1 percent
- o Total Varian service calls - 13

1.6 COMPUTER SOFTWARE/TERMINAL USAGE (See Glossary of Computer Terms, page xiii)

1.6.1 Computer Software

The computer software is divided into two major functions: (1) Data Concentrator and (2) MEDICS Application Software. Generally, the MEDICS Application Software usage reflects about 24 percent of the total computer usage, and the Data Concentrator function utilizes about 76 percent.

The usage of the Data Concentrator, MEDICS, and the terminals was related to the number of requests recorded. There are approximately three lines of input associated with each request for the Data Concentrator. These inputs averaged between 1200 and 1500 per month. The January usage was significantly lower because of above-normal computer down-time.

The MEDICS software usage is divided into three categories: (1) Users, (2) Program Usage, and (3) Data Base Usage. Relationship between Programs and Data Bases is illustrated in Fig. 1-2.

The eight main users of MEDICS are Sells Medical Records, Programmer, LMSC, Sells Chief Pharmacist, Santa Rosa Medical Records, Nurses, Paramedics, and Others. Sells Medical Records, LMSC, and the Programmer account for 84 percent of the total usage. There are five main programs available to the users: (1) RETRVL, (2) INPUTP, (3) SCHEDULE, (4) UPDATE, and (5) OTHERS. The RETRVL, INPUTP, and SCHEDULE account for 84 percent of the total usage.

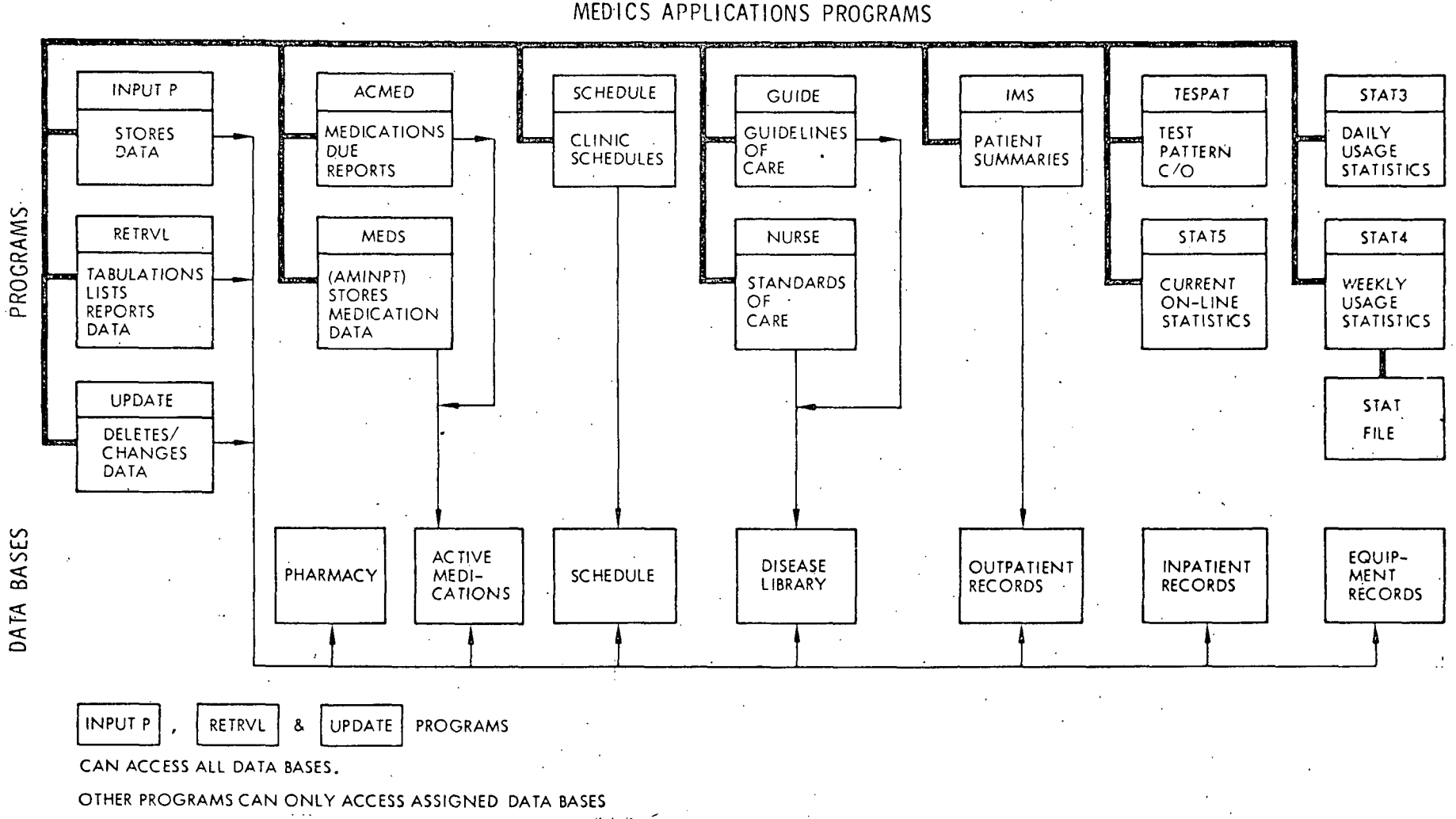


Fig. 1-2 Programs/Data Bases Relationship

There are 4 main data bases: (1) Schedule, (2) Equipment Records, (3) Pharmacy, and (4) Active Medications. The Schedule and Equipment Data Bases account for 84 percent of the total usage.

1.6.2 Terminal Usage

In determining terminal usage, both the statistics on the Data Concentrator and MEDICS Application program usage were reviewed. Those terminals devoted primarily to patient health care represent 85 percent of the total terminal usage. These terminals are located in the Sells Medical Records (3), Santa Rosa Clinic (2), MHU (2), San Xavier Medical Records (1), Nurses Station (1), and the Pharmacy (1). The remaining terminals are the four dial-up lines and the Phy/Ops CRT Terminal. These terminals reflect such patient health care usages as the IHS patient summaries, and this usage represents about 4 percent. Thus, a total of at least 89 percent of all terminal usage can be attributed directly to patient health care. The remaining 11 percent is primarily devoted to Equipment Records data base usage and checkout.

1.7 POWER EQUIPMENT USAGE

Power equipment (generators) are used at the HSSCC, LHSC, QRS, and in the MHU. Total usage time is recorded by running time meters on the MHU, LHSC, and HSSCC equipment and by telemetry recording at QRS.

The HSSCC diesel generator operates as a backup to the utility power. During inclement weather and/or power variations from the utility supply, the diesel generator is manually turned on. Because a major source of problem for the computer has been identified as the utility power supply at Sells, increasing use has been made of the diesel generator. Total generator running time during the past 3 months has been 250 hours.

LHSC propane generator is used only in emergency when the main utility power shuts down. There has not been a reported emergency incidence where this was required. The generator is exercised once a week for 15 minutes during routine maintenance checks (18 hours over a 6-month period).

The QRS power supply configuration was described under the QRS usage section. Running time on the WDG is estimated at 21 days over the 6-month period (12 hours/day operation), whereas the diesel generator has run 120 days (12 hours/day operation). The propane generator has only been used during refueling periods and used less than 100 gallons over the 6-month period.

The MHU power supply is normally furnished by the trailer generator. Two villages, Pisinimo and Kerwo, have utility power available at the MHU stops. Total operating time during the 6-month period is 1215 hours.

Section 2

HARDWARE EVALUATION RESULTS

2.1 UTILIZATION AND PERFORMANCE OF SYSTEM EQUIPMENT

The utilization of system equipment with emphasis on monthly trends, failure rates, high/low usage, and ratios between medical use and communication for other purposes (not related directly to medical) has been analyzed and is presented in summary form.

Two major data sources were available for analyzing and determining the utilization and performance of the system equipment: (1) The Telecommunication Equipment (TCE) usage log (contains performance data on 22 TCE types - See Table 2-1), and (2) Usage data on equipment at QRS, MHU vehicle, Computer and Supporting Peripheral Equipment, and Power Equipment.

Monthly data are presented covering the current 6 months and are compared with the prior 6 months. One year totals (the sum of both) also are given on a month-to-month basis for an overview of the operation from start to the end of this reporting period.

Telecommunications are defined in accordance with the purposes that they serve. Engineering telecommunications are concerned with checkout, troubleshooting, communications (between engineering personnel and/or engineering personnel and health care personnel), and control signal transmissions. Medical telecommunications are concerned with contacts between the CHM/Physician and Medical and Administration personnel. Teleconsultations contacts are specific medical communications between the CHM and the Physician.

2.1.1 Medical Telecommunications/Teleconsultation Contacts (CHM/Physician and MED/Administration)

The use of the STARPAHC system by the health care personnel is presented in Table 2-2 which summarizes the total activities over the second 6-month period and gives a comparison between total Telecommunications, Medical Telecommunications, and Teleconsultation contacts. The most significant factor is the monthly increase of the medical telecommunications; equally important, medical use accounted for 61.5 percent of the total Telecommunications. (Teleconsultation contacts accounted for 26.2 percent, while transmissions between MED/Administration accounted for 35.3 percent).

Table 2-1

GLOSSARY OF TELECOMMUNICATION EQUIPMENT TERMS

Telecommunication Equipment Type	Description
Color TV, Patient View	Patient viewing color TV system which includes the camera, monitor, and local camera control unit.
Color TV, Patient View Microscope	Surgical microscope for endoscopic examination which includes color camera, fiberoptics viewing bundle, light-source microscope, and ceiling-mounted track.
Color TV, Lab Microscope	Laboratory microscope which includes binocular microscope, light source, light filters, camera adapter, and color TV camera.
Black and White TV, X-Ray	Black and white X-ray viewing system which includes black and white TV camera, X-ray viewer, local camera control unit, and camera mount.
Black and White TV, Physician (HSSCC)	Black and white camera in physician's console used to transmit the physician's image for viewing by the patient at the remote facility.
Black and White TV, Slo-Scan (HSSCC)	Black and white camera located near the physician's console used to transmit X-ray images as part of the slo-scan system. Includes black and white TV camera, mount, X-ray viewer, and local camera control.
Handsfree, MUX	The handsfree intercom used for communication between the remote facility and HSSCC. Includes intercom units and audio multiplexer unit.
Handsfree, TV	The TV handsfree intercom generally used as backup for the MUX handsfree intercom.
Privacy, Audio, Remote	The privacy audio channel used for private conversations between CHM and the Physician. Includes the CHM hand/headset at the remote facility.
Hotline	The hotline is the communication link between the Operator's Console, and the CHM is the link in a remote facility. When one handset is removed from its cradle, the unit at the other end rings until it is answered.
VHF	The VHF radio system used when the MHU is enroute or the microwave system is not operational.
Order Wire	A special audio channel within the microwave system used primarily for maintenance and troubleshooting.

Table 2-1 (Cont'd)

Telecommunication Equipment Type	Description
Telemetry (QRS)	The control and telemetry system used to remotely control the QRS Relay Station from HSSCC.
ECG	The Cardiostat T single-channel electrocardiogram unit including the transmitter (oscillator).
Heart Sounds	The "Tonoscope" or battery-powered stethoscope used primarily to transmit heart sounds.
VTR	The Video Tape Recorder located in the communications rack (HSSCC) used to record incoming video from a remote facility or local from the Physician's Room.
Audio/Instrumentation Recorder	The audio recorder located in the communication rack (HSSCC) used to make audio recordings and to record ECG's.
Slo-Scan	The Slo-Scan units at HSSCC and PRC used to transmit/receive X-ray images, photographic, and graphical data.
Color Camera Phy (HSSCC)	Color camera in Physician's Room to record color image of patients, etc., primarily from Slo-Scan transmission.
PAM	Portable Ambulance Module (MHU and Sells Emergency Room).
Telecoupler	The telephone acoustical coupler located at the Physician's Console used to patch the handsfree intercom into the dial telephone for calling the lab, medical records, etc.
Telemetry Remote Camera Control	The Remote Camera Control Units located at both the Operator's and Physician's Console at HSSCC used to remotely control TV cameras at either remote facility.

Table 2-2

TOTAL TELECOMMUNICATION/MEDICAL TELECOMMUNICATION COMPARISON

Month	Total Telecommunication	Medical Telecommunications CHM/PHYS.	MED/ADMIN.
November 1975	275	78	60
December 1975	308	63	98
January 1976	359	106	137
February 1976	269	45	119
March 1976	386	88	186
April 1976	425	150	113
TOTAL	2022	530 *	713

Medical Use
(1243)

* Teleconsultation Contacts.

Table 2-3

TCE USAGE BOX SCORE/MONTH

Period: 01 May 1975 Thru 30 April 1976

	Try			Quality					Purpose					
	Try	Fail	PAR*	Exc.	Good	Fair	Poor	Fail	C/O	Trbl-Shoot	Comm.	Cont.	Chm/Phy.	Med/Adm.
MAY 1975	216	4	98.15* 96.76**	1	208	2	1	4	9	2	57	17	37	94
JUNE 1975	240	4	98.33 93.33	2	222	9	3	4	25	4	110	5	27	69
JULY 1975	342	6	98.25 88.89	8	296	25	7	6	40	1	119	32	64	86
AUGUST 1975	465	6	98.71 84.73	5	389	44	21	6	51	7	113	58	145	91
SEPTEMBER 1975	484	14	97.11 94.83	16	443	9	2	14	33	12	132	42	138	127
OCTOBER 1975	229	9	96.07 90.39	1	206	6	7	9	19	0	80	40	62	28
NOVEMBER 1975	275	3	98.91 94.55	0	260	11	1	3	10	5	90	32	78	60
DECEMBER 1975	308	5	98.38 86.36	0	266	26	11	5	31	2	81	33	63	98
JANUARY 1976	359	6	98.33 87.19	0	313	32	8	6	6	0	83	27	106	137
FEBRUARY 1976	269	4	98.51 86.99	0	234	21	10	4	16	1	61	27	45	119
MARCH 1976	386	7	98.19 86.01	0	332	38	9	7	32	3	54	23	88	186
APRIL 1976	425	8	98.12 92.00	3	388	21	5	8	26	1	89	46	150	113
Annual Totals	3998	76	98.10* 89.87**	36	3557	244	85	76	298	38	1069	382	1003	1208

*Gross PAR
**Net PAR

Table 2-4

USAGE TABULATION/TCE TYPE

Period: 01 November 1975 Thru 30 April 1976

	Use			Quality					Purpose					
	Try	Fail	(%) PAR	Exc.	Good	Fair	Poor	Fail	C/O	Trbl. Shoot	Comm.	Cont.	Chm/ Phy.	Med/ Adm.
01 Color TV, Pat View	166	8	95.1	2	114	32	10	8	48	1	3	0	97	17
02 Color TV, Pat View Mic	0	0	–	0	0	0	0	0	0	0	0	0	0	0
03 Color TV, Lab Mic	10	2	80.00	0	6	1	1	2	8	1	0	0	0	1
04 B&W TV, X-Ray	29	2	93.10	0	24	2	1	2	9	0	0	0	20	0
05 B&W TV, Phy (HSSCC)	178	3	98.31	0	168	5	2	3	12	0	5	0	77	84
06 B&W TV, Phy X-Ray (HSSCC)	0	0	–	0	0	0	0	0	0	0	0	0	0	0
07 Handsfree, Mux	354	6	98.31	0	298	39	11	6	6	2	21	0	135	190
08 Handsfree, TV	5	1	80.00	0	4	0	0	1	1	1	0	0	1	2
09 Privacy, Audio, Remote	77	0	100	0	61	15	1	0	0	0	9	0	26	42
10 Hotline	607	4	99.34	0	594	9	0	4	1	3	214	0	108	281
11 VHF	191	1	99.48	0	174	9	7	1	3	0	157	0	1	30
12 Orderwire	41	0	100	0	41	0	0	0	1	2	38	0	0	0
13 Telemetry (QRS)	155	1	99.35	0	151	1	2	1	3	0	0	152	0	0
14 ECG	2	0	100	0	1	1	0	0	2	0	0	0	0	0
15 Heartsounds	9	1	88.89	0	3	2	3	1	4	2	0	0	3	0
16 VTR	12	3	75.00	0	3	2	4	3	0	0	0	0	4	8
17 A/I Recorder	0	0	–	0	0	0	0	0	0	0	0	0	0	0
18 Slo-Scan (X-Ray)	26	0	100	0	18	8	0	0	13	0	1	0	9	3
19 Slo-Scan (DATA)	14	1	92.86	1	10	2	0	1	10	0	1	0	1	2
20 PAM	0	0	–	0	0	0	0	0	0	0	0	0	0	0
21 Tel-Cplr	83	0	100	0	62	21	0	0	0	0	7	0	24	52
22 Telemetry Remote CC	63	0	100	0	61	0	2	0	0	0	2	36	24	1
Totals	2022	33	98.36 88.82	3	1793	149	44	33	121	12	458	188	530	713 (1243)

*Performance Acceptability Ratio (PAR)

The occasional reduction in use of medical telecommunications is attributed to several factors. The CHM personnel assigned to Santa Rosa were transferred to Sells Hospital early in February. Replacement personnel had been trained in STARPAHC equipment and had demonstrated high proficiency in its use, but had fewer teleconsultations - probably because Sells physicians did not encourage teleconsultations; consequently, CHM refrains from using the system. Also, a large discrepancy exists between the number of teleconsultations between Sells and the MHU and Sells and Santa Rosa. Teleconsultation does not include use of the regular phone lines; the phone lines account for most contacts between Santa Rosa CHM and the Sells physician. (It is easier to use the telephone without having the Sells system operator contact the physician or medical record personnel.)

Even with the local variations, use of telecommunications continues to show an overall increase.

2.1.2 Telecommunication Usage Analysis

Tables 2-3 and 2-4 summarize the usage in terms of Use, Quality, Purpose, and by TCE type. Table 2-3 shows the cumulative total equipment usage box score for the period of May 1, 1975 through April 30, 1976. Table 2-4 shows the one year usage by TCE type. These tables are significant because the use data portray the continued high monthly number of telecommunication transmissions, the low monthly failure rate, and the resultant high Performance Acceptability Ratio (PAR). The quality of transmissions is shown to be predominantly good. Medical use accounts for over half of the telecommunications.

Number of Telecommunications. Figure 2-1 presents a summary of one-year telecommunications on a month-by-month basis. Average monthly telecommunications between the first 6-months and the second 6-months were practically identical (329 versus 337). High and low variations between the two periods showed fairly good correlation although, during the first 6 months, a high number of 484 telecommunications was reached in September 1975, while a high of 425 was reached during the second 6 months in April 1976. The lowest number of telecommunications occurred in the first month of operation (216 - May 1975). This is attributed to the start-up nature of the program. Lowest number of telecommunications during

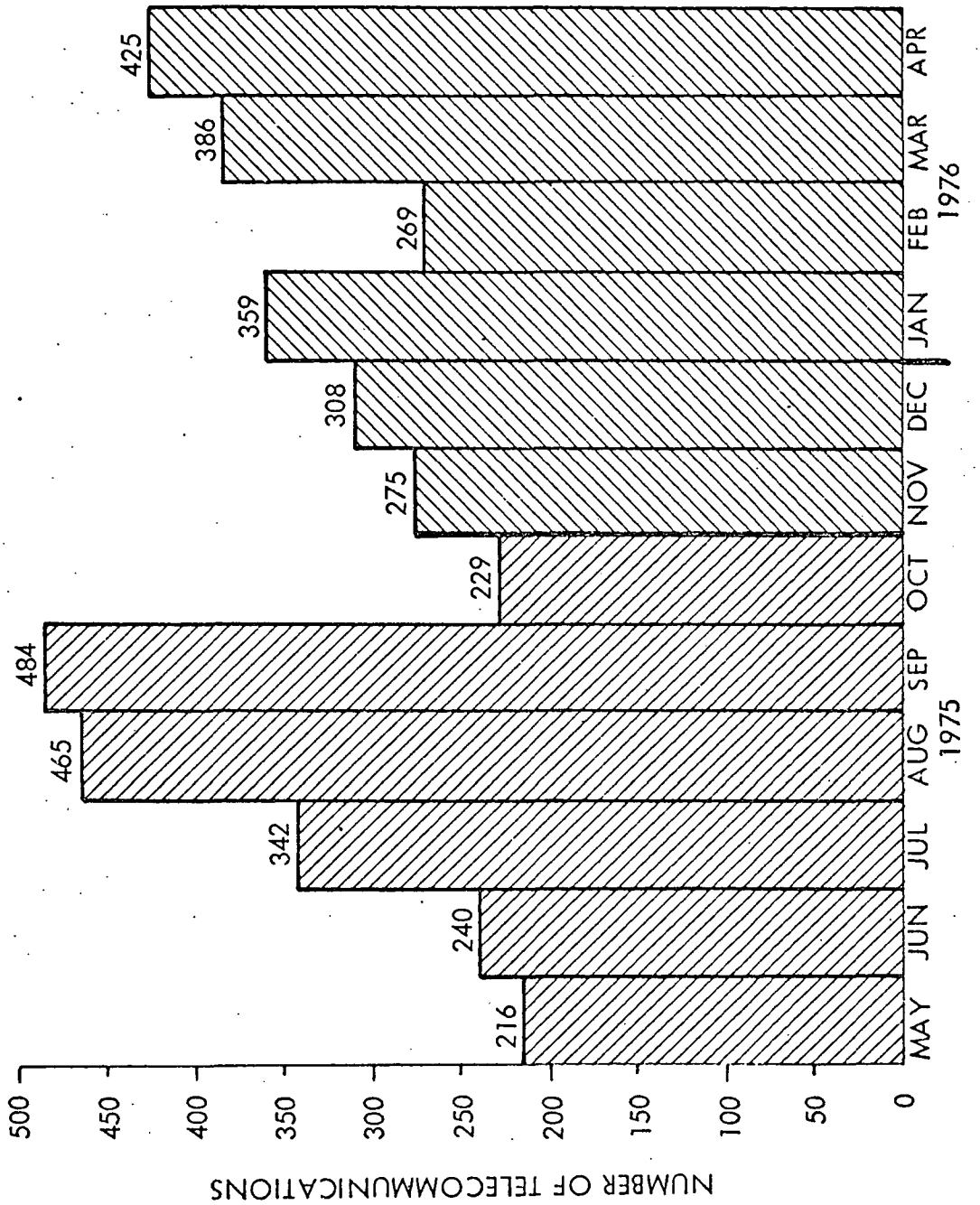


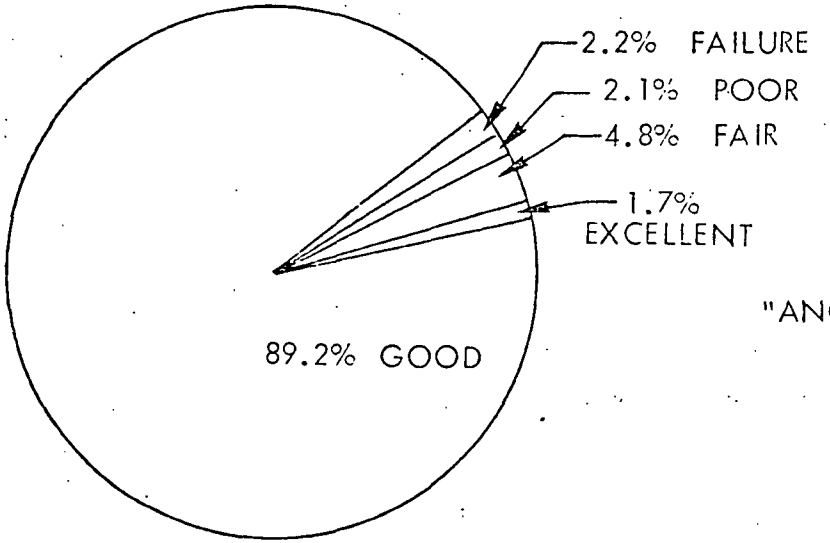
Fig. 2-1 Telecommunications Month-to-Month (12-Month Data)

the second 6-month period occurred in February 1976 (269) - probably because the flu epidemic required a large percentage of the CHM time for handling flu shots and medications, and also required a corresponding reduction in the need to consult with the Physician.

Checking the maximum difference in telecommunications between any two months during the first 6 months and the second 6 months shows a difference of 268 compared to 156. Checking the maximum difference in telecommunications between each preceding month shows a difference of 256 compared to 117. This is interpreted that the larger differences in the first 6 months are attributed to the shake-down factor whereas the second 6 months is demonstrating a more stable period with differences in monthly telecommunications smoothing out. Reasons for individual monthly differences during the second 6 months are more easily identifiable.

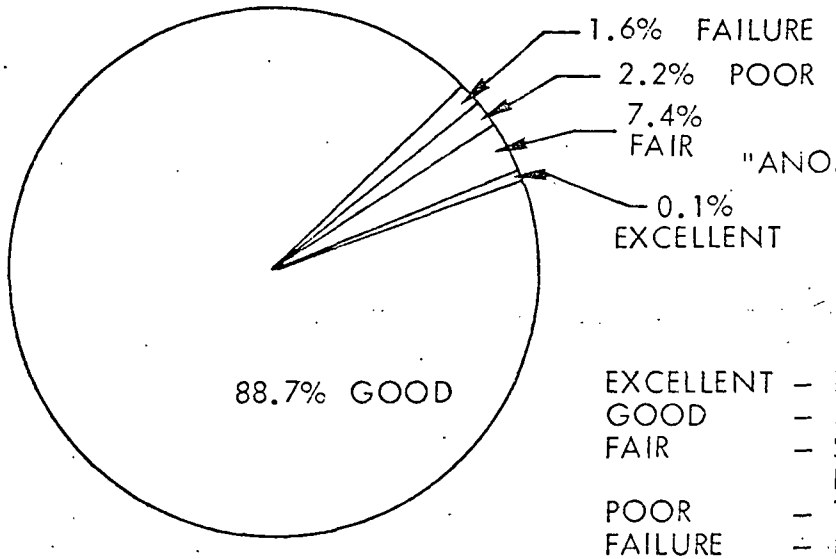
Performance Acceptability Ratio (PAR). The PARs are listed in Tables 2-3 and 2-4 for each month and for each of the 22 TCE types respectively. In assessing the percent of success as a ratio of the number of failures to the number of transmissions, (Gross PAR) for the year of operation shows 98.10 percent while Net PAR shows 89.87 percent. Reviewing each month's PAR shows the maximum difference between any month was 3 percent. Comparison between the two 6 month periods (See Table 1-1) showed equally good correlation between Gross and Net PARs. The Medical Use showed a significant increase (48.98 percent to 61.47 percent for the two time periods).

Quality of Transmissions. During the one year of operation, there were 3593 transmissions of Excellent/Good quality out of a total of 3,998 telecommunications, or a net PAR of 89.9 percent. Excellent ratings were reserved for video transmission with excellent contrasts and observations of minute detail. There was a significant reduction in that quality rating during the second 6 months because the operator became more critical in assigning Excellent ratings. The combination of Excellent/Good shows very little variation month-to-month. Net PARs show very little variation month-to-month. A summary of the distribution of quality ratings during the two 6-month periods are illustrated in Fig. 2-2. The quality rating of telecommunications is not significantly different between the two periods,



MAY THROUGH OCTOBER 1975

QUALITY	TELECOMMUNICATIONS
EXCELLENT	33
GOOD	1764
"ANOMALIES" FAIR	95
"ANOMALIES" POOR	41
"ANOMALIES" FAILURE	43
TOTAL	1976



NOVEMBER 1975 THROUGH APRIL 1976

QUALITY	TELECOMMUNICATIONS
EXCELLENT	3
GOOD	1793
"ANOMALIES" FAIR	149
"ANOMALIES" POOR	44
"ANOMALIES" FAILURE	33
TOTAL	2022

DEFINITIONS OF QUALITY

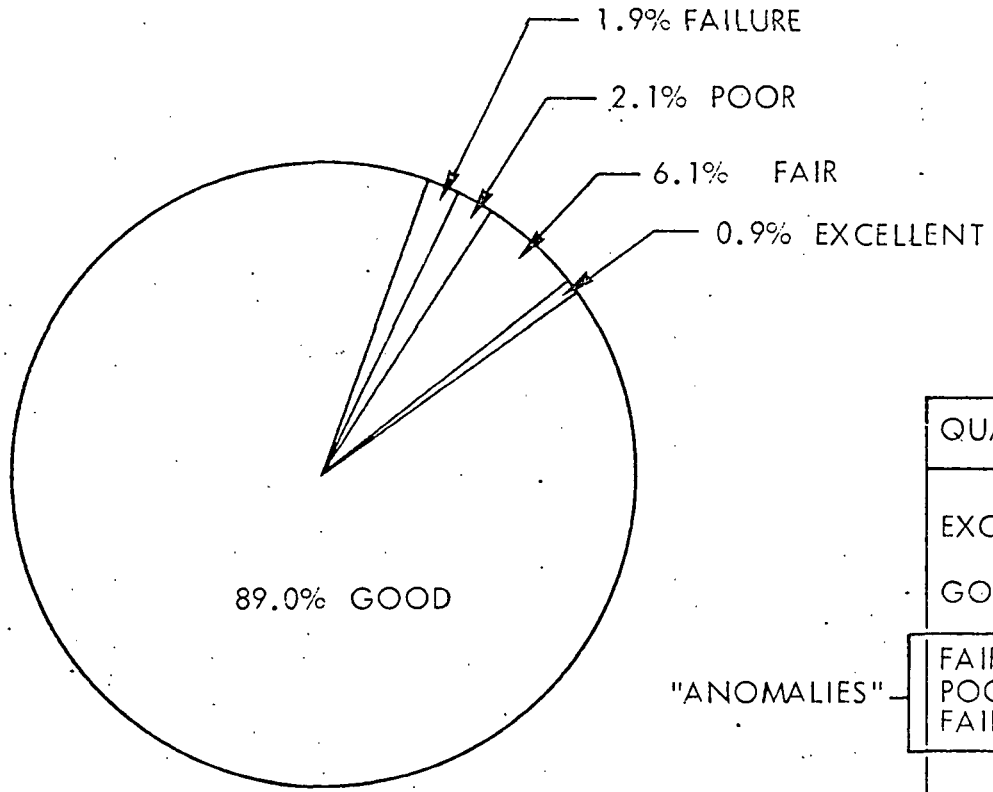
EXCELLENT – EXCELLENT CONTRASTS; MINUTE DETAIL OBSERVED.
GOOD – NOISE PRESENT; NO PRACTICAL DEGRADATION.
FAIR – SOME DEGRADATION; NOISY BACKGROUND, BUT FULLY HEARD AND SEEN.
POOR – TRANSMISSION; BUT STRAINING TO SEE AND HEAR.
FAILURE – NO TRANSMISSION; NOT ACCEPTABLE.

Fig. 2-2 Quality of Transmission (First and Second 6 Months)

except for the reduction in percent of Excellent rating from 1.7 percent in the first 6 months to 0.1 percent in the second 6 months. For a 1-year assessment of the quality of telecommunications, Fig. 2-3 shows that the Good quality rating is by far the largest percentage (89.9 percent), with Fair next at 5.1 percent, and the remaining three quality ratings, Poor, Failure, and Excellent making up the small balance of percentages remaining.

Purpose of Transmission. Six categories (Table 2-3) were established to determine the specific purpose of each transmission over the one-year period of operation. Figure 2-4 shows the percentage breakdown for the purpose of the telecommunications. During the first 6 months, medical purpose use accounted for 49 percent; during the second 6 months, there was a significant increase to 61.4 percent. Other categories such as control, communications, checkout/troubleshoot have shown a reduced usage from 51 percent to 38.6 percent. Medical use increased because health care personnel achieved better understanding of the system capabilities and a growing familiarity with its use. The reduction in the engineering use is attributed to a reduction in the number of trouble reports and the stability in operation caused by the resolution of some of the early start-up problems. Note that the percentage of use for control purposes is similar during the two periods which would be attributed to the normal operation requirements. For the overall year, Fig. 2-5 shows the CHM/Physician and the Medical/Administration use accounted for 55.3 percent of the transmissions, (the division between CHM/Physician and Medical/Administration is 25.1 percent and 30.2 percent, respectively). Figure 2-5 shows that checkout and troubleshooting for the LMSC maintenance/repair function accounted for 8.4 percent of the transmissions.

Communications between LMSC technical personnel and the IHS health care personnel accounted for 26.7 percent of the nonmedical transmissions. Control accounted for 9.6 percent and was used for telemetry signals to operate the moveable MHU antenna at the Quijotoa Relay Station and for remote operation of the TV cameras.



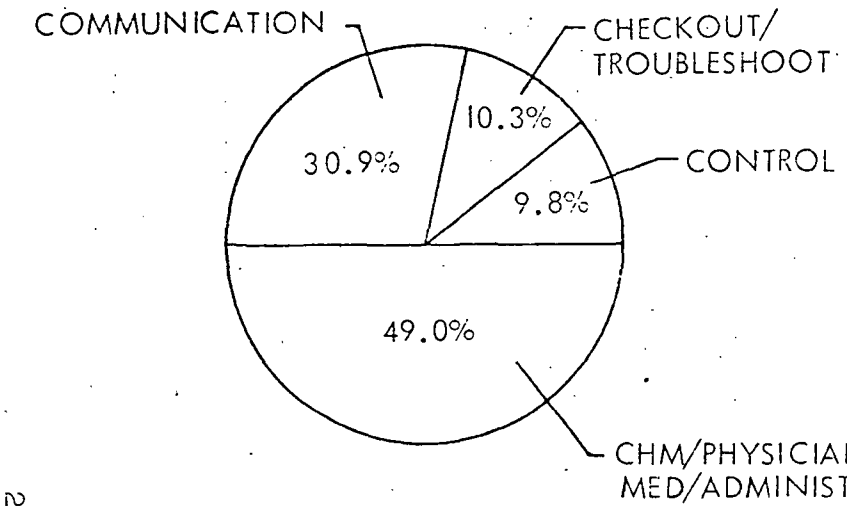
MAY 1975 THROUGH APRIL 1976

QUALITY	TELECOMMUNICATIONS
EXCELLENT	36
GOOD	3557
"ANOMALIES" FAIR	244
POOR	85
FAILURE	76
TOTAL	3998

DEFINITIONS OF QUALITY

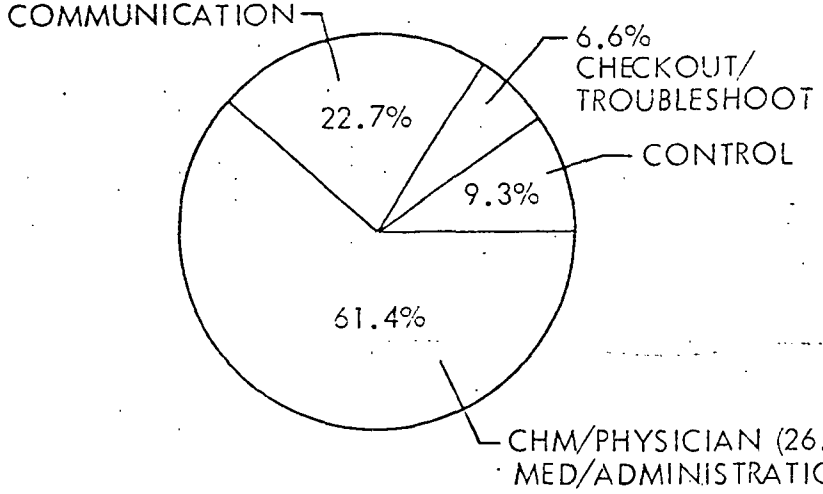
EXCELLENT	-	EXCELLENT CONTRASTS; MINUTE DETAIL OBSERVED.
GOOD	-	NOISE PRESENT; NO PRACTICAL DEGRADATION.
FAIR	-	SOME DEGRADATION; NOISY BACKGROUND, BUT FULLY HEARD AND SEEN.
POOR	-	TRANSMISSION; BUT STRAINING TO SEE AND HEAR.
FAILURE	-	NO TRANSMISSION; NOT ACCEPTABLE.

Fig. 2-3 Quality of Transmission (Full 12-Month Operations)



MAY THROUGH OCTOBER 1975

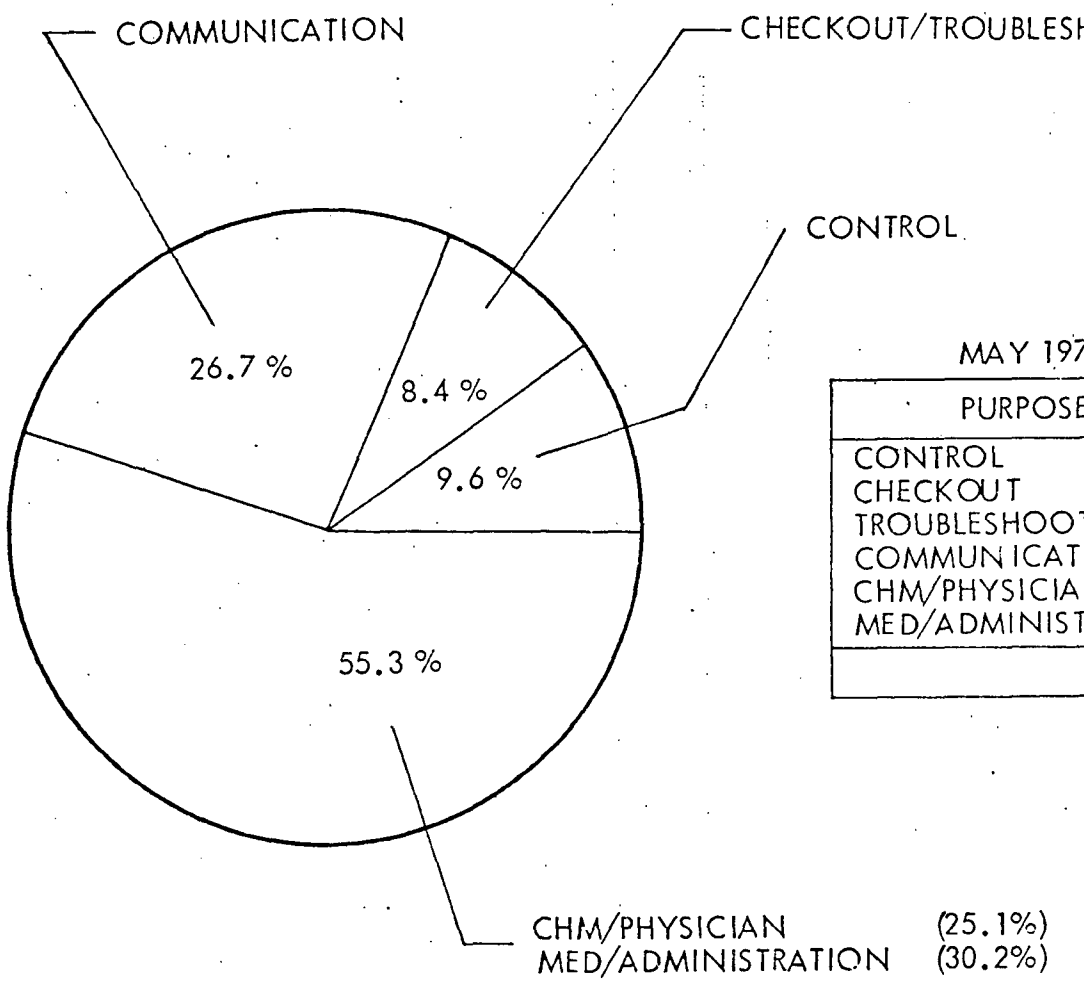
PURPOSE	TELECOMMUNICATIONS
CONTROL	194
CHECKOUT	177
TROUBLESHOOT	26
COMMUNICATION	611
CHM/PHYSICIAN	473
MED/ADMINISTRATION	495
TOTAL	1976



NOVEMBER 1975 THROUGH APRIL 1976

PURPOSE	TELECOMMUNICATIONS
CONTROL	188
CHECKOUT	121
TROUBLESHOOT	12
COMMUNICATION	458
CHM/PHYSICIAN	530
MED/ADMINISTRATION	713
TOTAL	2022

Fig. 2-4 Purpose of Transmission (First and Second 6 Months)



MAY 1975 THROUGH APRIL 1976

PURPOSE	TELECOMMUNICATIONS
CONTROL	382
CHECKOUT	298
TROUBLESHOOT	38
COMMUNICATION	1069
CHM/PHYSICIAN	1003
MED/ADMINISTRATION	1208
	TOTAL 3998

Fig. 2-5 Purpose of Transmission (Full 12-Month Data)

Figure 2-5 shows the distribution of Purpose of Transmission over the full 1-year operation. Percentages are fairly consistent with the prior two 6-month distributions, except for medical transmission. It is anticipated that the medical transmissions will continue at a higher percentage in the next 6-month period.

Usage Time Analysis. A significant reduction in the total telecommunication transmission time occurred during the past 6 months compared to the first 6 months. The reduction in the time for telecommunications is attributed to the following factors: (1) Initial long transmissions resulted from personnel learning curve, (2) More efficient use was developed, and (3) Total patients' visits increased significantly as a result of the flu epidemic in February, but resulted in fewer and shorter telecommunications because health care personnel were primarily concerned with dispensing medications.

Figure 2-6 illustrates the time reduction. Note, however, the rapid increase in Medical Telecommunication time in the last two months as compared with the reduction in Engineering time. The trend is anticipated to continue over the next operational period.

Figure 2-7 illustrates the number of telecommunications by Purpose in Reference to the number of transmissions and the time of transmissions. Data for the two 6-month periods are shown. As noted in the two boxes on the figure, there is little difference in the number of transmissions (1976 versus 2022), however, the time varies from 518:30 for the first 6 months to 337:00 hours for the second 6 months. It is equally significant that, although there is an increase in the number of telecommunications for medical use, (49.0% to 61.5%), there is a marked reduction in medical use time (230:18 to 192:18 hours). In the case of engineering use, there was a significant reduction in the number of telecommunications (51% to 38.5%) and also a corresponding decrease in telecommunications time (288:12 to 144:42 hours).

	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
ENGINEERING	55:20	74:00	36:06	48:30	44:06	30:18	17:12	28:36	13:30	25:12	34:36	26:36	434:00
MEDICAL	61:48	18:48	35:40	49:12	49:30	14:36	21:12	23:18	33:12	19:36	40:42	53:54	421:30
												TOTAL	855:30

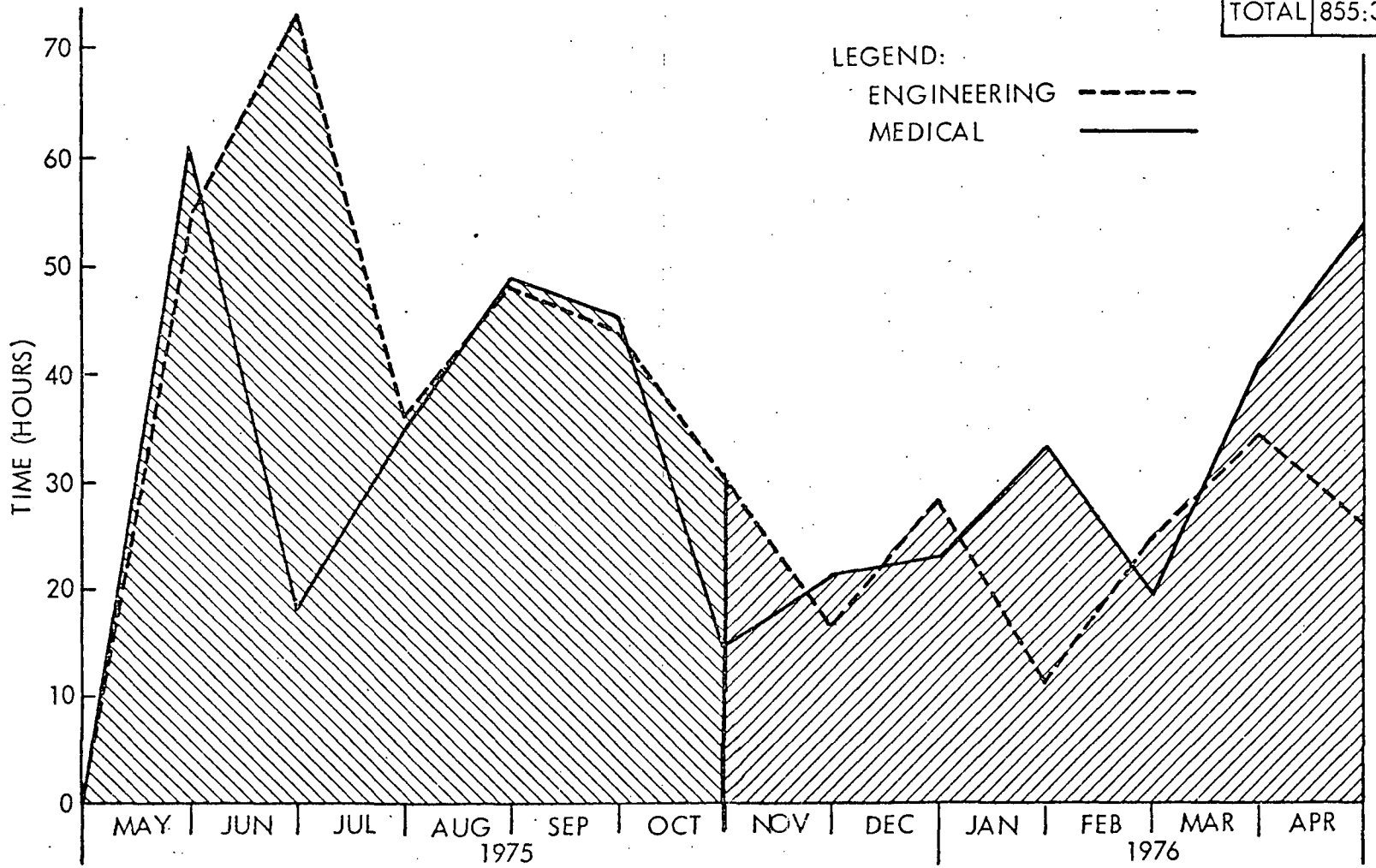
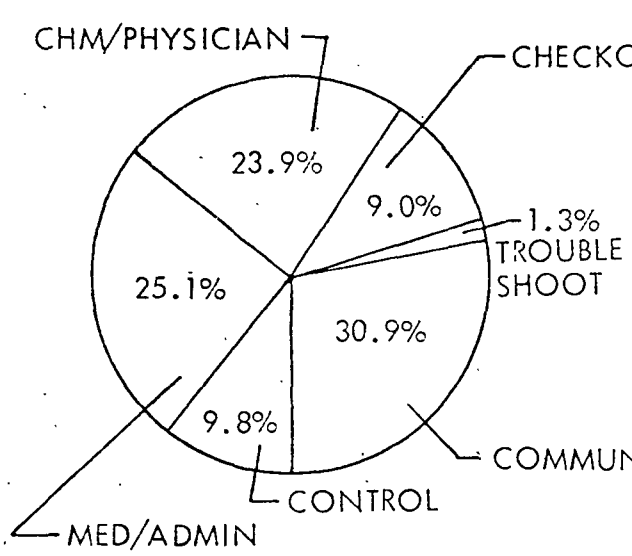


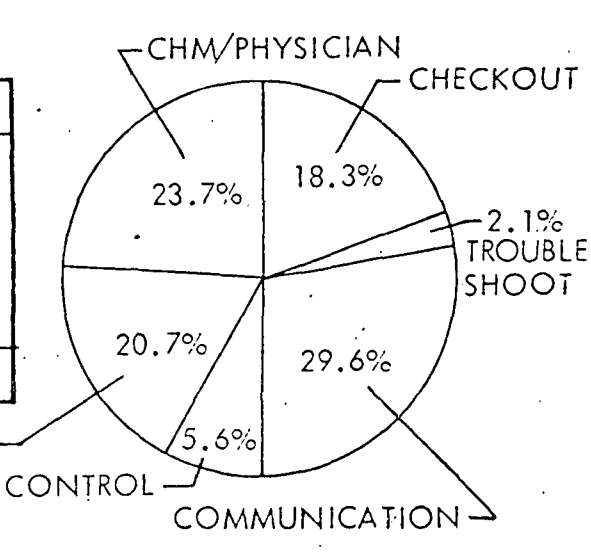
Fig. 2-6 Time Spread in General Telecommunications Purpose



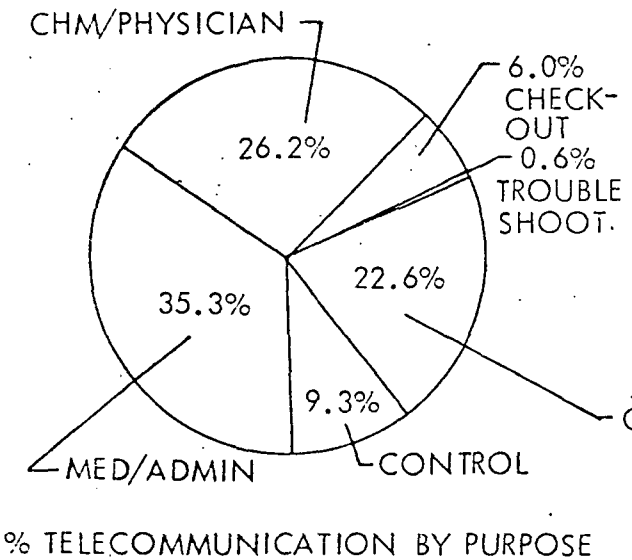
% TELECOMMUNICATION BY PURPOSE
(NUMBER OF TRANSMISSIONS)

MAY THROUGH OCTOBER 1975
(TELECOMMUNICATION/TIME)

	TELE	TIME
CHECKOUT	177	94:48
TROUBLESHOOT	26	11:00
COMMUNICATION	611	153:18
CONTROL	194	29:06
CHM/PHYSICIAN	473	122:48
MED/ADMINISTRATION	495	107:30
TOTALS	1976	518:30



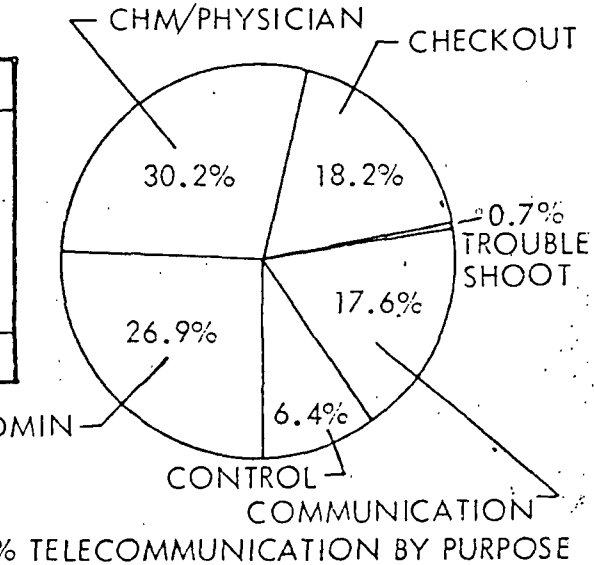
% TELECOMMUNICATION BY PURPOSE
(TIME OF TRANSMISSION)



% TELECOMMUNICATION BY PURPOSE
(NUMBER OF TRANSMISSIONS)

NOVEMBER THROUGH APRIL 1976
(TELECOMMUNICATION/TIME)

	TELE	TIME
CHECKOUT	121	61:18
TROUBLESHOOT	12	2:24
COMMUNICATION	458	59:24
CONTROL	188	21:36
CHM/PHYSICIAN	530	101:42
MED/ADMINISTRATION	713	90:36
TOTALS	2022	337:00



% TELECOMMUNICATION BY PURPOSE
(TIME OF TRANSMISSION)

Fig. 2-7 Percent of Telecommunications by Purpose (Number/Time for Two 6-Month Periods)

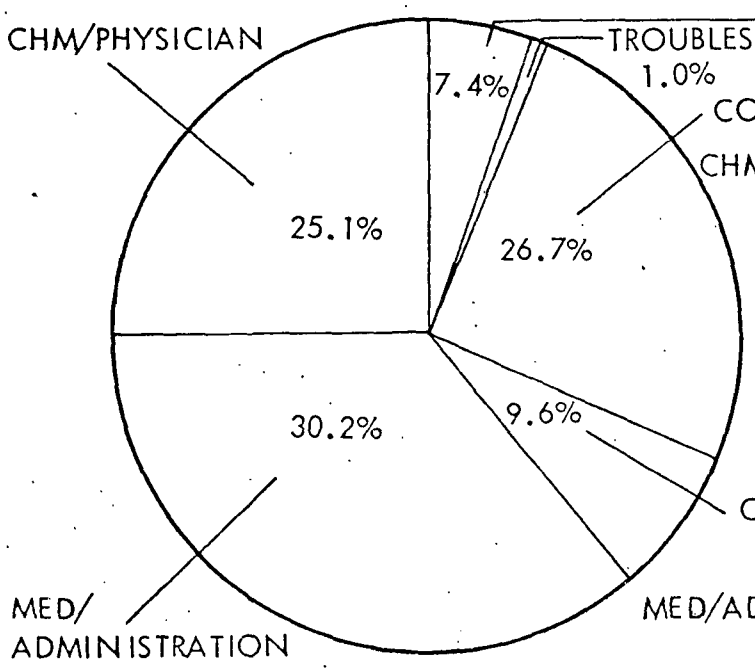
Figure 2-8 shows the comparison between the two 6-month periods. The initial high increase in telecommunication transmissions tapered off and a fairly steady usage rate developed in the last 6 months. It is anticipated that the telecommunication time/number is stabilized and will continue during the next 6 months. Increases, if any, in the number of telecommunication transmissions and time of usage will probably be associated with unusual demands made on the system.

Usage of TCE. Figure 2-9 compares the usage of individual equipment types by the CHM/Physician or by other users. Equipment with less than 7 percent of the TCE usage total are excluded. Some of the equipment that receives high usage is primarily dedicated to systems support functions and is not intended for medical use, e.g., Antenna Positioner Telemetry (QRS). Low usage rate of the VHF for medical use is also understandable because VHF is normally used by the driver of the MHU and is used only for medical purposes when normal transmission (narrowband/wideband) links are not available.

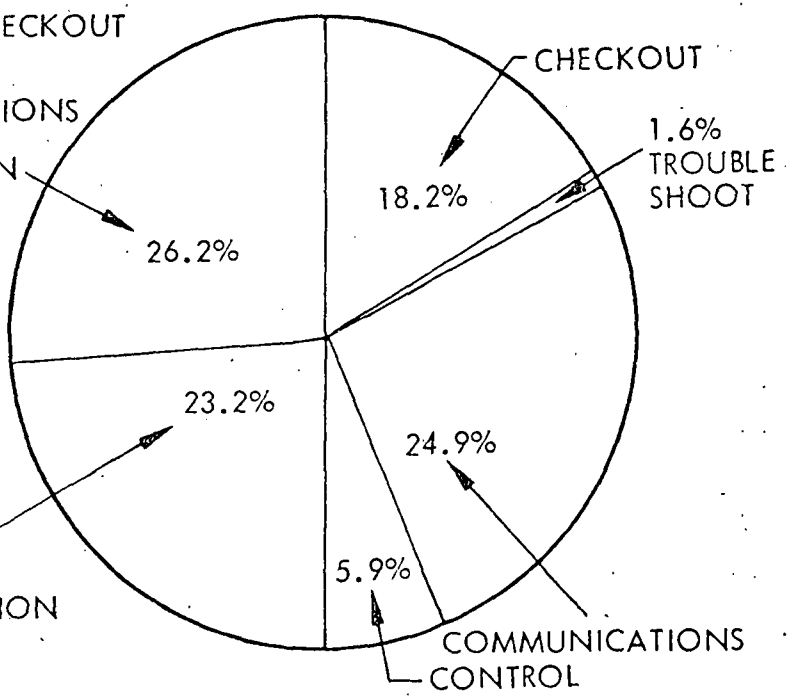
The TCE quality ratings were reviewed. The gross PARs for the 22 TCE types are listed on Table 2-4. Note that out of the nine most-used TCE, the Privacy Audio Remote, Tel-Cplr, and the Telemetry Remote Control have no failures. The highest failure rate has been experienced by the Color TV, Patient Viewing equipment (PAR 95.15 percent). The remaining TCE types have shown high PARs (98 to 99 percent).

The quality ratings for the nine most used TCE shows predominantly as Good (89.9 percent). There were 23 failures for the group out of the total of 33.

Figure 2-9 shows the nine most used TCE accounted for 92.7 percent of the total, or 1874 telecommunications out of the total of 2022. Of the 1874 telecommunications, Engineering Purposes accounted for 42.3 percent, with Medical Purposes at 57.7 percent.



% TELECOMMUNICATION BY PURPOSE
(NUMBER OF TRANSMISSIONS)



% TELECOMMUNICATION BY PURPOSE
(TIME OF TRANSMISSIONS)

MAY 1975 THROUGH APRIL 1976
(TELECOMMUNICATION/TIME)

	TELE	TIME
CHECKOUT	298	156:06
TROUBLESHOOT	38	13:24
COMMUNICATION	1069	212:42
CONTROL	382	50:42
CHM/PHYSICIAN	1003	224:30
MED/ADMINISTRATION	1208	198:06
TOTALS	3998	855:30

Fig. 2-8 Percent of Telecommunications by Purpose (Full 12-Month Data)

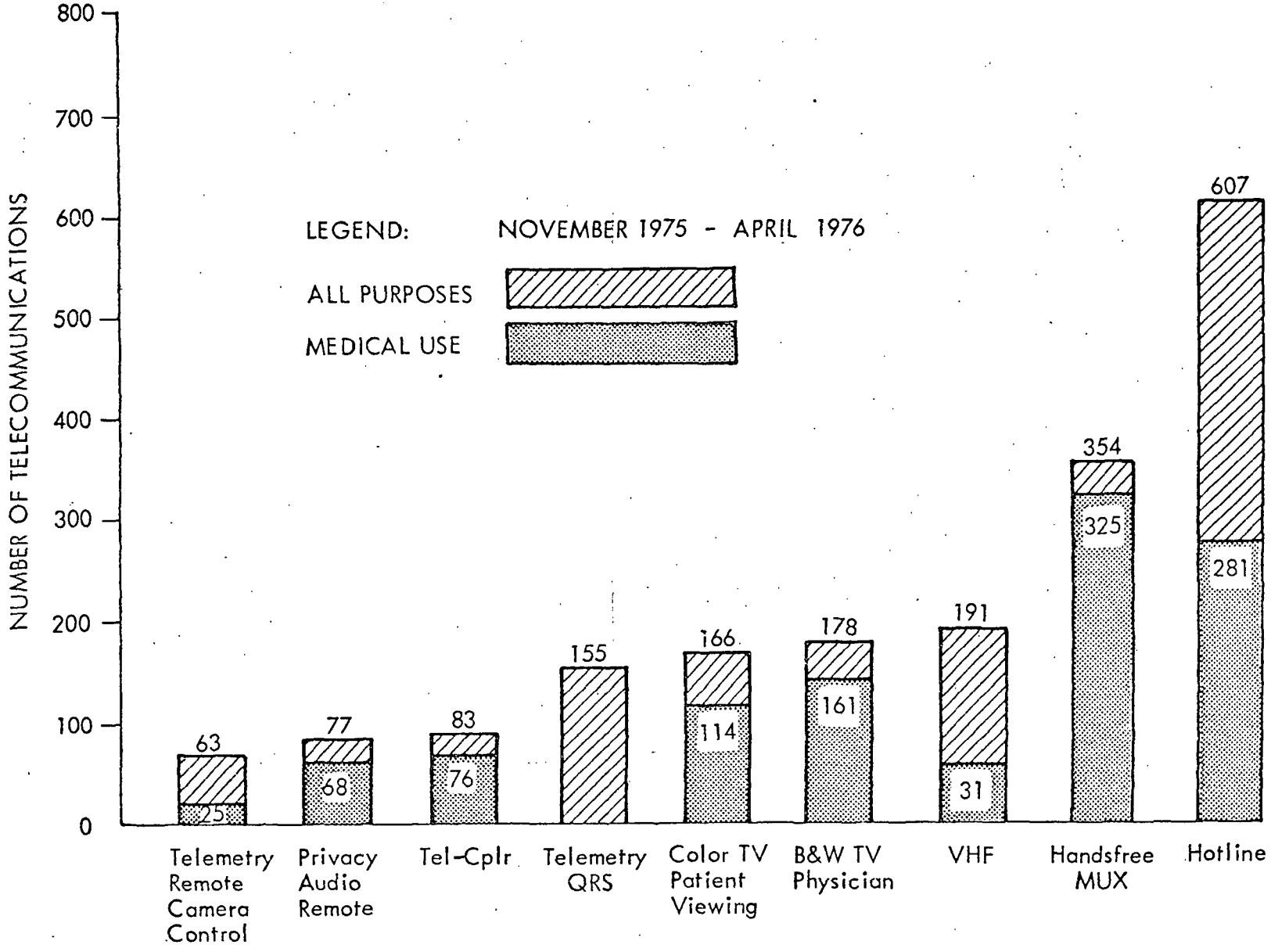


Fig. 2-9 TCE Usage

2.1.3 Quijotoa Relay Station (QRS) Equipment Evaluation (Table 2-5)
During the 6-month reporting period, the QRS power equipment consisted of a wind-driven generator (WDG) as primary power, a 6.0-kilowatt diesel generator as backup, with a 2.5-kilowatt propane generator available in emergencies. Although the WDG suffered extensive damage early in its operation (see Appendix A), sufficient operational experience has proven the feasibility of the configuration. The most important aspect of the evaluation of the configuration is an appreciable reduction in time-consuming and noneconomical logistic support requirements to frequently provide diesel/propane. Valuable test data are being gathered for future applications. Utilization of expendables for the QRS is listed on Table 2-5. The data compared to the first 6 months show the impact of reduced logistic support.

2.1.4 MHU Vehicle and Supporting Equipment (Table 2-5)
Maintenance technicians who performed routine maintenance Friday and Saturday evaluate the MHU vehicle and its supporting equipment. Equipment operation discrepancies are noted by IHS personnel on a daily report. This report is used by the technicians during routine weekly maintenance duties, and corrections are made as soon as possible. Discrepancies requiring immediate action while the MHU is in the field are remedied by having the maintenance technician visit the respective MHU stop without delay.

Detailed maintenance records as to oil, water, tune-ups, tires, etc. (Table 2-5) were compared to the first 6 months of operation and were found to be similar, which indicates that no unusual wear-out has occurred. The driver noted the improvement in air conditioning resulting from the repairs in October.

During the first 6-month period, the Traveleze Trailer was modified to provide VHF voice/digital data capability to the MHU using STARPAHC spares inventory. This modification has remained intact for MHU substitution during periods of major maintenance and as a supplemental capability intended for trial during future months. Its use will be evaluated further at that time.

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Table 2-5

GENERAL EQUIPMENT USAGE

(QUINDIA RELAY STATION) Type #23

QRS Generators	Use Rate	6-Mo Supply	Remarks
Primary			
(Diesel)	25.2 gal/wk	529.2 gal	Diesel installed Nov. 6, 1975 replacing LPG fueled generator. (Estimate LPG assumed load for a total of 21 days during this period) (12 hr/day operation).
(Oil)	Change - 3 qt/2 wk	31.5 qt | 31.5 qt	
	Consumption - 0	0 qt |	
(Battery Water)	1 qt/mo	5.2 qt	
(Fuel Filters) (2 ea.)	2/3 mo	4 filters	
(Oil Filter)	2/mo	12 filters	
Secondary			
(LPG)	100 gal/6-mo period		Operated once each week for exercise in addition to service periods of Diesel.
(Oil)	Change - 4 qt/6 mo	4 qt | 4 qt	
	Consumption - 0	0 qt |	
(Battery Water)	2 qt/mo	12 qt	
(Points)	0	0	
(Spark Plugs)	0	0	

MHU VEHICLE AND SUPPORTING EQUIPMENT (Type #24)

MHU Vehicle	Use Rate	6-Mo Supply	Remarks
Fresh Water	40 gal/wk	1020 gal	Resupply on a weekly basis
X-Ray Rinse Water	20 gal/wk	510 gal	
Toilet Waste	20 gal/wk	510 gal	If Thermosan operates, use is substantially reduced
Sink/X-Ray Waste Water	35 gal/wk	892.5 gal	
X-Ray Chemicals			IHS supplied
Tires	10,000 mi (rear)		IHS supplied
	17-20,000 mi (front)		
Gas Consumption	4 mi/gal	1225 gal	Mileage records show total of 15,280 mi
Gas Generator (Aux.)	0.5 gal/hr per 16 hr/day	832 gal	(Total 2420 hr)
Primary Generator	4.0 gal/hr for 5 hr/day	2060 gal	(1215 hr)
Battery Water (MHU)	1/2 gal/mo	3 gal	
Battery Water (Primary Gen.)	None - sealed unit		
Air Conditioner	5 hr/day - 4 day/wk	520 hr | 936 hr	
	8 hr/day - 2 day/wk	416 hr |	
Oil (Vehicle Eng.)	Air Breather - 1 qt/mo	42 qt	
	Oil Change - (3000 mi) 10 qt - 3 times		
	Oil Consumption - 1 qt/mo		
Aux Generator (MHU)	Oil Change - 3 wk/4 qt	55.5 qt	
	Consumption - 0.75 qt/wk		
Primary Generator (MHU)	Oil Change - 6 wk/6 qt	35 qt	
	Consumption - 1 qt/3 wk		
Spark Plugs (MHU)	6/5,000 mi	12 plugs	
Spark Plugs (Primary Gen.)	Once/3 mo (6) plugs	12 plugs	
Spark Plugs (APU)	Once/3 wk (2) plugs	17 plugs	
Points (MHU)	1 set/5000 mi	2 sets	
Points (APU)	1 set/mo	6 sets	
Points (Primary Gen.)	1 set/3 mo	2 sets	

MHU VEHICLE

MHU Vehicle	Use Rate	6-Mo Supply	Remarks
Oil Filter (MHU)	1/3,000 mi (3 times)	3 filters	
Oil Filter (APU)	1/3 wk	8.6 filters	
Oil Filter (Primary Gen.)	1/6 wk	4.3 filters	
Air Filter (APU)	1/3 wk	8.6 filters	
Transmission Oil/Brake Fluid	None required	None required	
Antifreeze	3 gal	3 gal	One radiator flush
Chassis Lubrication	4 lb/lube	8 lb	Lub period 3 mo
Carburetor Cleaner	1/2 can/mo	3 cans	One 12-oz can lasts 2 mo
Engine Degreaser	2 cans/mo	12 cans	14-oz cans
Toilet Paper, Chemicals	-	-	IHS supplied

COMPUTER AND PERIPHERAL SUPPORT EQUIPMENT (Type #25)

Data Equipment	Total Time (Hr)	Use Rate (Hr/Day)	Remarks
CPU	4320	24	
Diablo Disc Drive	2842	11	Use rate may vary
Century Disc	2842	11	Use rate may vary
Mag Tape Unit	300	2	
Card Reader	1300	10	
Line Printer	300	2	
Card Punch	300	2	
Selis Hospital Terminals	1350	9	
MHU Terminals	800	6	
TTY	1300	10	

POWER EQUIPMENT (Type #26)

LHSC Generator	Use Rate	6-Mo Supply	Remarks
Oil	1/2-qt/20 hr	6-qt estimated	Generator is standby (50-hr total)
Water	None		
Air Filter	1/6 mo	1	
Propane	3-gal for checkout only	3-gal checkout only	Emergency estimate is 36 gal for 6 mo

	Use Rate/Mo	6-Mo Use
LHSC Generator	3 hr/mo estimated	18 hr
QRS Generator		
Primary	342 hr/mo	2052 hr
Standby	12 hr/mo	72 hr
MHU Generator		
Primary	173 hr/mo	1038 hr
APU	350 hr/mo	2100 hr

2.2 COMPUTER SOFTWARE/TERMINAL EVALUATION

The statistics used in evaluating software and terminal usage were gathered from the STAT3 report (see Glossary), produced at the end of the day on the STARPAHC computer. If the system should fail or be brought down for any other reason, this STAT3 report can be requested upon demand. The STAT4 report is produced weekly and analyzes the STAT3 data. STAT4 counts the number of times a terminal signs on and the total terminal time. However, if the system should fail, the statistics gathered by STAT3 are lost, and the STAT4 report becomes incorrect. Also, tabulations of users, program usage, and data base usage must be hand-calculated. Therefore, the STAT4 report was not used in generating the Software and Terminal Usage Evaluation because of the excessive downtime of the computer. Manual evaluation of the STAT3 data was utilized for this report.

In evaluating the computer software usage, a count was tabulated each time a program was requested. This count then reflects the user, program name, data base, and terminal used.

STAT3 was modified for the STARPAHC computer to include the Binary Synchronous Communication (BSC) line statistics gathered by the Data Concentrator. These statistics report a count of lines input to and output from the IBM 370 computer via the BSC line. Line errors sent or received also are counted. The count of inputs were used to evaluate the software usage.

The Computer Software Evaluation usage data was collected by separating the function into two categories: 1) MEDICS Application Program usage and 2) Data Concentrator Program usage. The MEDICS applications are utilized 24 percent of the time, and the Data Concentrator programs were used 76 percent. In reviewing the operational procedures necessary to deliver patient health care, these percentages represent the expectations of the evaluation. The HIS patient's health summary (retrieved via the Data Concentrator) is retrieved every time a patient is seen in the various clinics. The MEDICS programs were designed to augment some of the bookkeeping and record-keeping functions within the hospital and specialty clinics; therefore, their usage was expected to be

lower than the Data Concentrator functions. As the system becomes more reliable, the MEDICS applications will be utilized more, but the Data Concentrator functions also will be utilized more. There should be very little variations in these percentages.

2.2.1 MEDICS Application Program Usages

The MEDICS Application Program Usage reports include analysis of 1) Users, 2) Programs, and 3) Data Bases. In terms of patient health care delivery, all three reports should be given careful consideration. Data were calculated using the STAT3 reports, counting the number of times a user made a program request, how many times a program was requested, and which, if any, data base was used. Because a great deal of the MEDICS usage was devoted to maintenance of the Equipment Records data base, this report was divided into these three categories to show usage devoted only to patient health care.

Users. Each time a user signs on to the STARPAHC computer, the system records his name, the line number he is using, and the various programs that may be used. The following percentages and those shown in Fig. 2-10 reflect counts of those users of the MEDICS Application Programs. As shown by these figures, Sells Medical Records showed 43 percent of the total usage. This usage, combined with the Sells Chief Pharmacist, Santa Rosa Medical Records, Paramedics, and Nurses gives a total of 54-percent usage devoted entirely to patient health care. The Programmer usage indicates maintenance, both of data entry and reports, of the Equipment Records Data Base. LMSC usage also is for Equipment Records retrieval. Because of the new operational procedures developed for Active Medications, usage by Sells Chief Pharmacist and Nurses is expected to increase significantly in the next 6-month reporting period. The Others category includes users such as NASA, HPSC-OMIS, Santa Rosa R. N., Gordon Moore (M.D.), and Sells R. N.

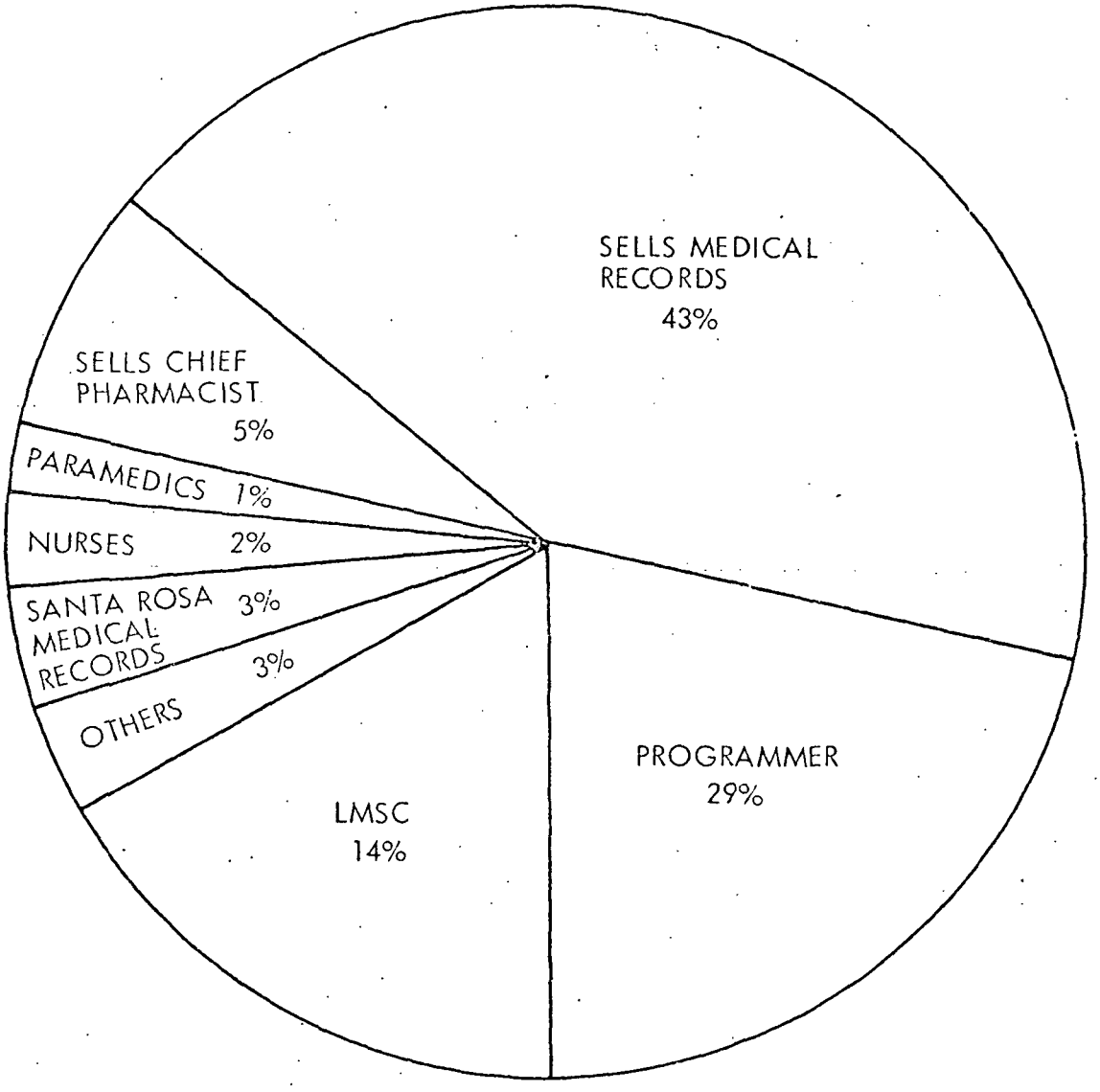


Fig. 2-10 MEDICS Users

	Percent
Sells Medical Records	43
Programmer	29
LMSC	14
Sells Chief Pharmacist	5
Santa Rosa Medical Records	3
Nurses	2
Paramedics	1
Others	3

These users' error rates run about 8 percent. Error rates are counts of those programs whose names were misspelled (i.e., SHCEDL rather than SCHEDULE), INPUT rather than INPUTP, etc.) or when RETRVL, INPUTP, or UPDATE are called and no data base was used.

Programs. The RETRVL, INPUTP and UPDATE programs are used by all the various subsystems. In scheduling patients for specialty clinics, the user stores patient data utilizing the INPUTP program. The RETRVL program gives the user a tabulation of all the patients to be seen at a specific clinic and shows name and patient ID for retrieval of HIS patient summaries. The SCHEDULE program is used to determine the next available time a patient can be seen at a specialty clinic. The UPDATE program is used to purge from the data base those patients who have already been seen at the clinic; therefore, the Program Usage Report would show usages in all of these programs. To determine Schedule usage involved in patient health care, the Data Base Usage or User's Report should be analyzed.

The Active Medications subsystem also involves various programs. This subsystem is undergoing operational changes. The Pharmacy personnel are taking over the data maintenance requirements. The Nursing Station is using the special reports to aid in dispensing medications. Use of this subsystem is expected to increase during the last month of this reporting period and to be used continually throughout the remainder of the program.

The following percentages and Fig. 2-11 reflect the program usages. ACMED, MEDS, and NURSE usages are shown in the Active Medications percentages. These usages are expected to increase. RETRVL, INPUTP and UPDATE are all on data bases. Therefore, program usage percentages cannot be considered accurately with regard to patient health care. The SCHEDULE program usage as well as the Active Medication function usages are devoted entirely to patient health care and collectively represent 23 percent usage.

	Percent
RETRVL	40
INPUTP	25
UPDATE	7
SCHEDULE	19
ACTIVE MEDICATIONS	4
OTHERS	5

The Other category represents GUIDES (used by Paramedics), IMS, STATS, and TESPAT.

Data Bases. As shown in Fig. 2-12, the SCHEDULE data base had the highest ranking usage - 49 percent. This usage, combined with Active Medications, Disease Library, and the Pharmacy data bases totals 65-percent usage devoted directly to patient health care. The Others category includes Outpatient Records and Inpatient Records. Usages in these two data bases were devoted only to program checkout. These two data bases currently are not being used by the operational staff because of insufficient clerical personnel.

	Percent
SCHEDULE	49
EQUIPMENT RECORDS	35
PHARMACY	6
ACTIVE MEDICATIONS	6
DISEASE LIBRARY	2
OTHERS	2

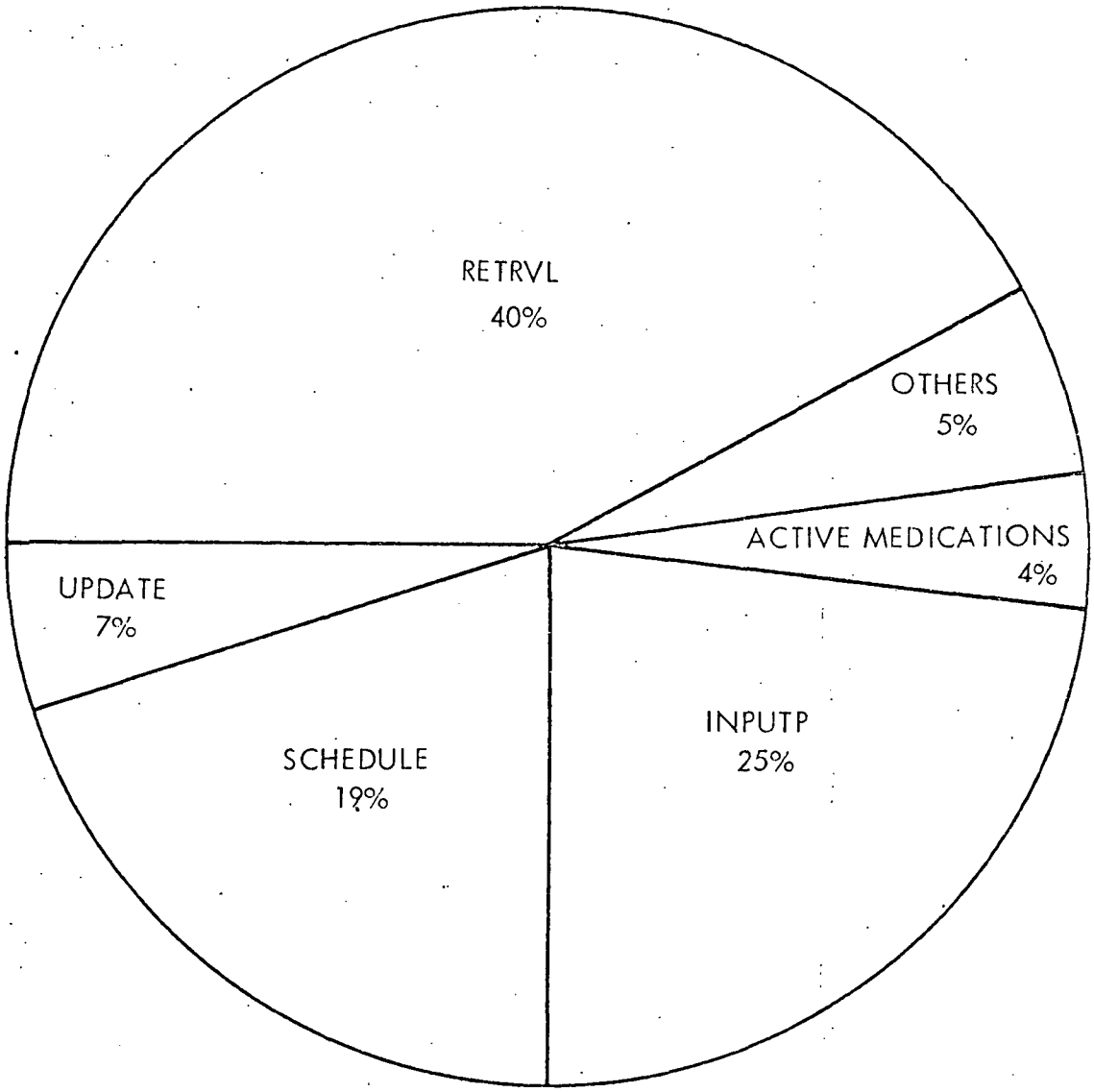


Fig. 2-11 MEDICS Program Usage

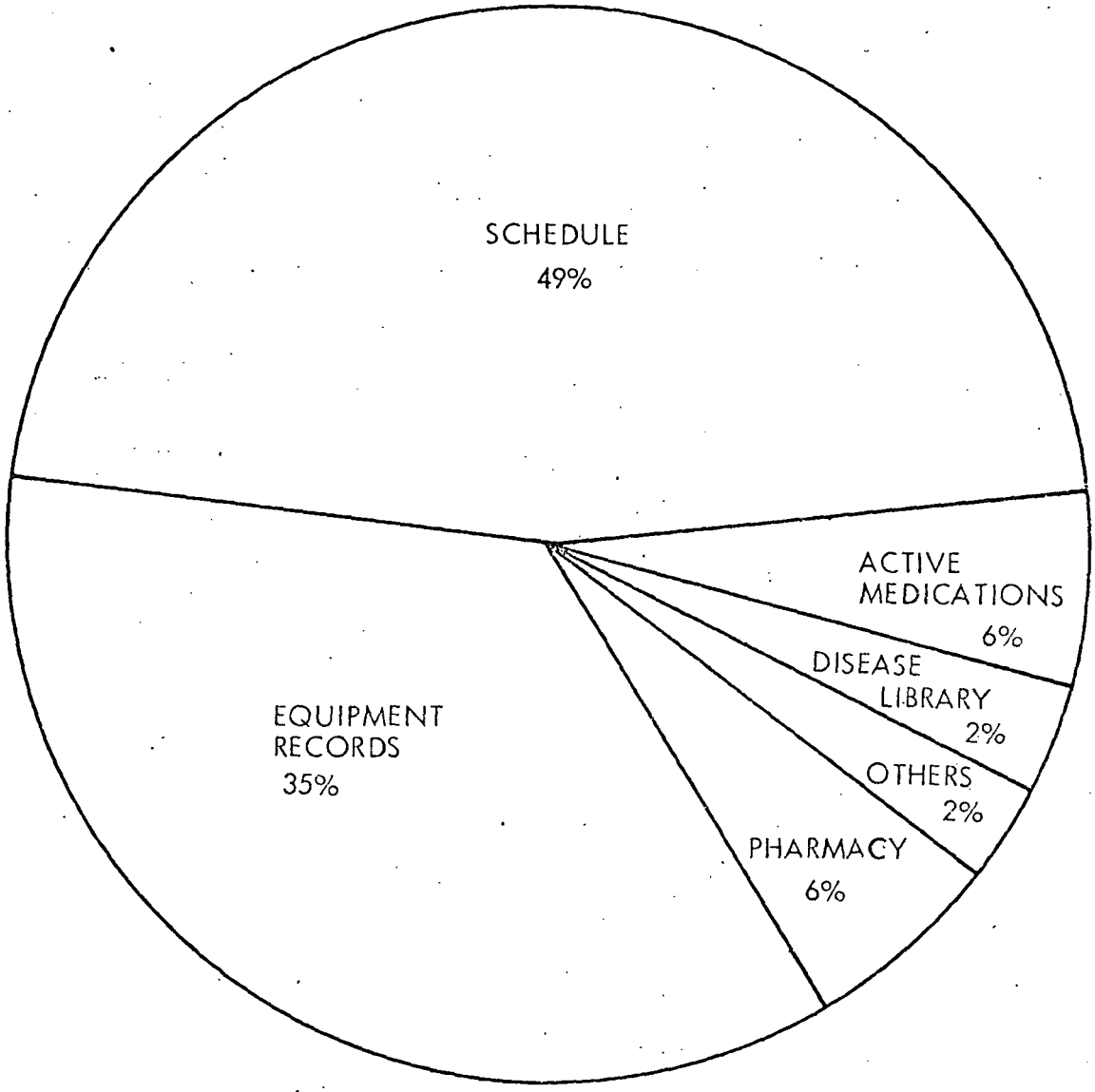


Fig. 2-12 MEDICS Data Base Usage

As the new operational procedures come on line for Active Medications, these figures are expected to change significantly. Also, the Disease Library usage should increase because the Hazeltine Terminal was brought back on line March 15. This terminal will now produce Nurse's Standards in the designed format.

2.2.2 Data Concentrator

Each time a patient is seen by the various IHS facilities, a HIS patient summary is retrieved from the IBM computer in Tucson. This retrieval can be obtained through direct lines to the HIS computer or through the STARPAHC Data Concentrator. Use of the STARPAHC system is usually preferred because of speed and low-line costs.

The Data Concentrator input/output counts vary from month to month depending upon computer reliability and patient load. A user can retrieve one or several summaries with one request. The number of output lines can vary according to inputs. Naturally, if the user requested several patient summaries in his initial request, the number of outputs for that request are significantly greater than if he only requested one patient summary. There are approximately three lines of input associated with each request and over 100 lines of output per patient summary. The count of inputs was used in this report to reflect Data Concentrator usage and Terminal usage.

The Data Concentrator inputs average between 1200 and 1500 per month. The January usage was significantly lower because of above-normal computer downtime. The outputs range from 90,000 to 130,000 with a significant decrease in January, also.

The BSC line errors range from 20 to 50 per month. These errors are normally attributed to a noise on the telephone line, weather, etc. The February line errors were excessive because of HIS computer problems at Bell Aerosystems.

These figures do not reflect actual patient load. Several patient summaries can be requested at one time. Therefore, the counts can only reflect usage.

Month	Inputs*	Outputs*	Line Errors*
November 1975	1,280	90,219	19
December 1975	1,593	112,468	54
January 1976	891	69,731	27
February 1976	1,513	132,841	718
March 1976	814	57,991	103
April 1976	2,124	139,996	135
Total	8,215	603,246	1,056

*Caused by excessive down time, these statistics may be low.

As shown in the table, the difference between monthly inputs and outputs vary. Line error counts can be misleading. In February, one day showed 520 errors, while another day showed only 90 errors. Therefore, the large number of errors for February cannot be indicative of normal usage. The November and December line error rates probably are indicative of normal usage.

Figure 2-13 is a weekly graph of the BSC line usage. Low spikes in the graph are parallel with computer downtimes.

2.2.3 Terminal Usage

Terminals in the STARPAHC system are used for retrieving Indian Health Service Patient Summaries from the Data Concentrator and use of the MEDICS application programs for scheduling patients, storing and retrieving STARPAHC equipment data or for maintaining Medications for inpatients at the Sells Hospital. To determine terminal usage, we separated the statistics into Data Concentrator usage and MEDICS usage. Data was collected from the STAT3 reports. These reports show each MEDICS program usage giving the terminal or line number, the user's name, and the program used. The report also gives a count of the total number of inputs and outputs for each terminal devoted to Data Concentrator usage.

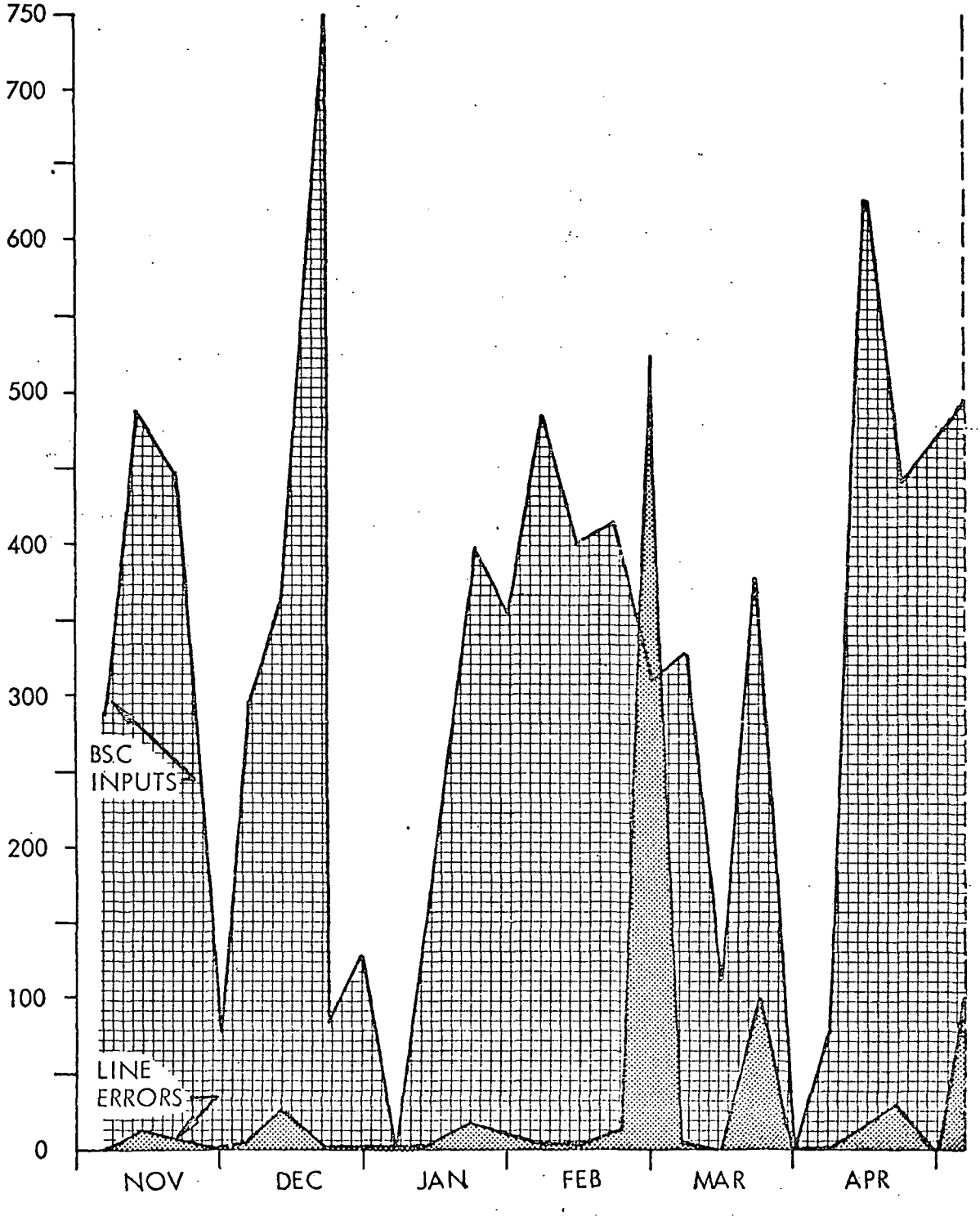


Fig. 2-13 Weekly BSC Usage

Table 2-6 shows the terminal percentage of usage with respect to retrieving patient histories from the Data Concentrator or use of the MEDICS programs. This table also includes the terminal percentages of usage for the total STARPAHC system. As can readily be seen, nine of these terminals show more than 50-percent usage devoted to the Data Concentrator in retrieving patient health summaries. Five terminals show primary usage of the MEDICS programs. These terminals are used for scheduling patients (No. 14, Follow-Up Clerk), maintaining medications for inpatients (No. 10, Pharmacy INFOTON CRT), and retrieving standards of care for Nurses and Paramedics (No. 3, Santa Rosa Exam INFOTON CRT). One terminal (Dial-Up, No. 8) was used only once during a MEDICS checkout program. This line has been out of service since August and was brought on-line in March.

Figure 2-14 shows the percentages of terminal usage for the total STARPAHC system (both Data Concentrator and MEDICS). These percentages also are shown in Table 2-6. Following is an explanation of these terminals in terms of patient health care delivery.

Percentage	Terminal
36	Sells Medical Records GE Hardcopy. This terminal is devoted 97% to retrieval of patient health summaries, patients seen at the outpatient and specialty clinics.
11	MHU Reception TI Hardcopy. 99% of this terminal's usage also is devoted to retrieving patient health summaries for those patients visiting the MHU.
10	Santa Rosa Medical Records CDI Hardcopy. 97% of this terminal's usage is devoted to retrieving patient health summaries for those patients visiting the Santa Rosa Clinic.
10	Sells Follow-Up Clerk TEC CRT. This terminal is used 96% for scheduling patients into the specialty clinics.
9	Sells Phy/Ops TEC CRT. This terminal is used 82% for maintaining the equipment data. The remaining 18% is used for retrieving patient summaries or the Physician during consultations.
7	Sells Medical Records CDI Hardcopy. 78% of this terminal's usage is devoted to retrieving patient health summaries. This terminal is used when the patient load exceeds those handled by the GE Hardcopy above.

Percentage	Terminal
7	San Xavier Medical Records. 99% of the terminal's usage is for retrieving patient summaries for those patients visiting the San Xavier clinic.
6	Dial Up, Line 5. This line is used by the Community Health Nurses for retrieving patient health summaries for those patients visited in their homes. This accounts for 58% usage. The remaining 2% is used by LMSC in retrieving equipment data and by NASA and HPSC-OMIS in interrogating the STARPAHC system.
4	Others. The remaining seven terminals are: MHU Exam TEC CRT, the Pharmacy INFOTON CRT, the Sells Nurses Station HAZELTINE, the Santa Rosa Exam INFOTON CRT, and the remaining three dial-up lines. These terminals are devoted to maintaining medicines for the inpatients and providing patient health summaries in the clinic exam rooms.

In totaling the percentages, we find that 85% of the usage was devoted exclusively to patient health care. However, in analyzing the usage of the Sells Phy/Ops CRT and the dial-up Line 5, we find another 4% was devoted to patient health care. This brings the total usage devoted to patient health care to 89%.

The next evaluation period should show increases in usages for the Sells Pharmacy INFOTON CRT and the Sells Nurses Station HAZELTINE when the new operational procedures for the Active Medications are instigated. This increase in usage should cause the total usage for patient health care to increase, also.

Table 2-6

TERMINAL USAGE

Line	Terminal	Data Concen. (Percentage)	MEDICS (Percentage)	Total Usage (Percentage)
1	MHU Reception TI Hardcopy	99	1	11
2	MHU Exam TEC CRT	92	8	1
3	Santa Rosa Medical Records CRT Hardcopy	97	3	10
4	Santa Rosa Exam INFOTON CRT	20	80	0.2
5	Dial-Up	58	42	6
6	Dial-Up	62	38	1
7	Dial-Up	54	46	0.3
8	Dial-Up	-	100	0.01
9	Sells Medical Records CDI Hardcopy	78	22	7
10	Pharmacy INFOTON CRT	19	81	1
11	Sells Medical Records GE Hardcopy	97	3	36
12	San Xavier Medical Records GE Hardcopy	99	1	7
13	Sells Phy/Ops TEC CRT	18	82	9
14	Sells Follow-Up Clerk TEC CRT	4	96	10
15	Sells Nurses Station Hazeltine	4	96	0.5

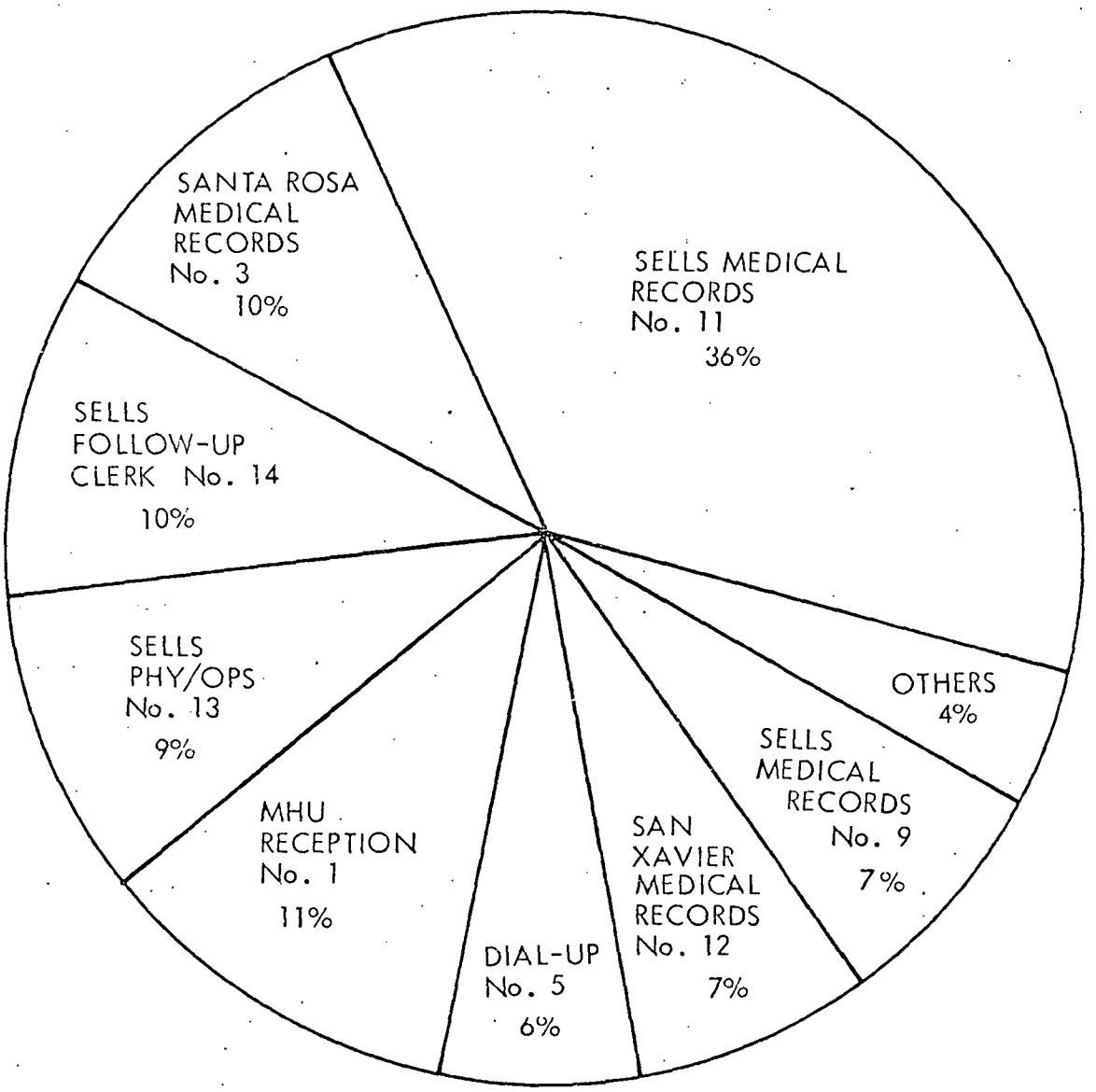


Fig. 2-14 Terminal Usage

2.3 HUMAN ENGINEERING EVALUATION

2.3.1 HSSCC

Operator/Communications Room. This room is the "nerve" center for the entire program; thus, operator efficiency can become a critical link. The physical space is minimum and hampers optimum operation, maintenance, and support activities.

Comfortable temperature, low noise level, and control of lighting provides a conducive environment for long-term monitoring.

The operator's console is a well-designed piece of equipment for the functions required. Reach to all switches and push buttons is adequate. Operator has a good view of all indicators and both television monitors. If more space could be made available, it would be used for an auxiliary desk to house operational books and manuals, a typewriter, desk phone, storage for ancillary test equipment, and generally more work surface.

The communications rack presents an arrangement of modules that require the operator to access controls from a standing reach to a low squatting position. Equipment requiring low usage, e.g., batteries, battery charger, etc., are located in the lower modules. Arm reach, operational and visual access to audio/video tape recorders is fair. VHF, order wire and all microwave equipment is conveniently located.

The proximity of the operator's console and layout of the room provides marginal operator convenience and inadequate maintenance access to front panel. Rear panel maintenance access is excellent.

A general assessment shows this room's work area could be considerably improved if more space were available.

Data Equipment Room. The major pieces of computer and peripheral equipment appear to be arranged efficiently to allow excellent use and maintenance, with the exception of the disc drive. The space allocated for this hardware is adequate, although more space could offer different optimal layouts. Because the individual hardware is vendor supplied, only a cursory evaluation was performed. The main computer frame and all of the support equipment have acceptable human interface.

As was noted in the operator's console/communications room, the greatest problem is inadequate facility space, not equipment deficiencies. Computer equipment that is sensitive to dust contamination should be isolated and not in a semipublic room shared by a telephone switchboard operator. The PBX operator is forced to work in a crowded corner and endure the noise normally associated with peripheral computer equipment. The partial sound-insulated wall is not sufficient to stop dust or noise.

A general assessment of this room shows it to be a good work area for STARPAHC personnel, but unacceptable environment conditions for the computer and the efficiency of the switchboard operator.

Physician's Room. Perhaps the best physical room size and layout for the intended use has been allocated to the physician, and rightly so. Being the key "user" of the system, the precious time of the physician should be enhanced by efficient console operation. It is apparent that much thought went into the design and integration of the physician's console and support equipment. The addition of many peripheral items such as the terminal and remote control unit tend to clutter the console/desk combination, and could help to burden and confuse the nontechnically trained physicians.

The size and style of the desk was an excellent choice. The chair position and room for movement side-to-side is sufficient to enable a good reach and visual access to controls on main console. Physician rheostat control of room lighting reduces glare on monitors but hampers good television transmission of his own image. Placement of this camera lens causes physician to lose "eye" contact

with patient as he monitors incoming television signal. Because it is preferred to use the color monitor, and the user is looking at and talking to the right-hand side of the console while the microphone is located toward the left side, its multidirectional capabilities can become borderline.

Controls and legends have been simplified for ease of operation. With the addition of an automatic answer phone, time stamp, audio coupler, slo-scan switching unit, and control box, it becomes necessary to provide an auxiliary table in the current location of the ECG receiver (at right angle to main console). This additional counter space could also support the two desk phones which now obscure the office intercom controls.

The present location of the main slo-scan unit is out of reach for the operation and difficult to service by the technician. Addition of Shibaden color camera control unit and black and white pan/tilt/zoom control could be stacked/repackaged or incorporated in second console with the aforementioned communication equipment.

Litton boom chosen for color camera mount is smooth operating and flexible enough to provide good camera articulation regardless of the gross interference with the black and white X-ray viewing camera. Boom has been rebalanced to avoid use of cumbersome ballast.

A general assessment of this room shows it to be an excellent work area.

2.3.2 LHSC

Emergency Room. The emergency control console was originally designed to be operated by a well-trained CHM or health care professional. In actual operation, because of staff limitations at Santa Rosa, it has been necessary to have the CHM operate the equipment as well as man the console. This condition, plus the design of the console, has presented problems. Desk selection places the operator on the left side in front of the power controls, the camera control on the right-hand bay, requiring right-hand operation. The desk space is adequate for writing or reading reference material. The H.P. cardiac monitor is externally mounted because of inadequate console space. A preferred installation would have been panel-mounted, although this would have required a 3-bay console. Legends and transmitting procedures could be simplified to avoid operator confusion. Installation of a simple hood over the color monitor is recommended to reduce glare from the necessary high ambient room lighting.

The patient viewing camera boom is sturdy, easily moved, and stays in place when positioned. The mechanics of the camera mount allow proper video orientation only when the boom is in a horizontal position. The boom counterweight should be padded to reduce chance of injury.

Exam Room. The communications shelf is placed high to avoid interference or a hazard to the CHM. This precludes optional viewing of the monitor or intercom access. The minimum space available in this room does not lend itself to repackaging equipment in a console. This room is used extensively for patient examination. A more optimal position is recommended for the television monitor.

The requirement for a portable patient viewing/X-ray camera is met by the camera on a tripod with an ample cord. The mounting of the camera actuation controls on a tripod leg is awkward to use. An X-ray illuminator box is placed at a convenient level and location in the room.

A general assessment of this room is functional, but adequate space and mobility requirements of the camera imposes nonoptimal equipment arrangement.

LHSC Laboratory. Inefficient placement of equipment requires extra reach effort by personnel in this room. Dedicated space and containerization of this equipment would enhance its use. Color TV microscope appears no more complex than need be, and position is comfortable for viewing. Support electronics for color television camera uses valuable counter space. Laboratory control panel could be relocated to provide easier accessibility.

A general assessment finds this room an adequate place to work, hampered by a dispersion of STARPAHC equipment and crowding of laboratory equipment.

LHSC Data Management Room. Good layout in room for maintenance access to communication racks and ample workbench for service tasks. Most often used color monitor and signal generator are mounted high in rack while heavy battery charger and power supply are mounted low.

2.3.3 MHU

General. The well-planned layout of rooms affords adequate space to support a high level of health care delivery. The general room lighting supported by few localized fixtures provides good illumination to all work surfaces. All counter heights are standard, and work surface areas are adequate within the confines of a mobile vehicle. There appears many extra unused electrical outlets.

Waste receptacles, towel dispensers, and bulletin boards should be added in each room. A small clothes closet would be beneficial to hide lab coats and crew garments. Forced by space requirements, overhead storage is too high to be useful. Lack of shelves and dividers in counter cabinets produces wasted space. The intercom system works well and is placed in appropriate locations throughout the vehicle, enhancing communication between crew members. The air conditioner appears easy to operate, has good distribution, and fairly quiet operation, all supporting a good working environment.

In general, it would be good practice to hide the "aerospace" communications hardware and articulated camera mountings as well as medical instruments and supplies to reduce psychological trauma in patients. In addition, the MHU is potentially a well-designed testbed. It is hampered by complex camera articulation.

Exam Room. The room layout provides good access to both sides of the exam table, with some crowding experienced during pelvic exams. The CHM's exam stool should be padded for comfort and have casters for mobility. Current stool crowds ready access to cabinets and drawers.

General room lighting is good, but exam light appears awkward to use and to stow for travel.

Audio communication controls are easily reached and centrally located.

Color television monitor locations and relationship to camera controls is optimal for most uses, but a swivel mount for monitor does not appear necessary.

Patient viewing camera and fiberoptics camera supports present a hazard to CHM and patient. More reduced head clearance is encountered at doorway from exam room to driver's compartment.

There is adequate cabinetry in this area; however, better distribution could improve efficiency of this work area.

Laboratory/Reception/Communication Room. Fixed location of microscope forces an uncomfortable viewing position for lack of knee space. Counter top seems adequate, fairly well lit and has good interface with other support equipment. Refrigerator access is also good.

Good reach to all communications controls is apparent, except the MUX radio which is too low and awkward to service. Tamboured doors over transmitter and TV monitor areas are excellent for concealment but work very stiffly.

A retrofit of cabinet interiors could provide custom dispensers for consumables which would conserve precious space. Several often-used pieces of laboratory equipment could have been built in to save set-up and stowage time.

A general assessment of this room finds it to be the most spacious and functional of the three major work areas.

X-Ray Room. The wet environment of the film developing area requires a counter with an overflow lip. Proximity of X-ray illumination box makes it subject to spills, creating a possible hazard. Overhead camera is oriented 90 degrees away from compatible format of X-ray illuminator.

Camera controls and monitor have good positioning relationship.

Refrigerator is located too low, in an awkward position to access, and is hinged on the wrong side.

X-ray head is located in good position for close-up shots on table or full chest shots across the room. Controls for X-ray machine are in good position, have excellent lighting and appear to be in a safe location for operator.

A general assessment of this room finds it to be adequate to take, develop, and transmit X-ray images. All other operations are hampered by space restrictions.

Lavatory. Space in the lavatory area is adequate for all intended functions. Compact corner sink was a good selection. Paper towel dispenser and trash receptacle is missing. Proper, simple (not written, but graphic) instructions for use of toilet pedals should be posted conspicuously.

Driver's Station. The driver is equipped with a very excellent seat providing good support and a soft ride. Dashboard gauge panel is at an undesirable angle, making quantitative gauge readings awkward.

Retrofit of automotive air conditioner partially blocks driver's view through windshield.

Exterior. Generally, all exterior compartments provide good access for maintenance of tanks or equipment enclosed. Awnings are too high and cumbersome to be operated safely.

Roof. The sturdy ladder and safety cable promote confidence while erecting antenna. Hydraulic assist is good, but folding support leg attachment and alignment is difficult and possibly injurious to hardware. Access to meters and radio communication for correct antenna positioning is excellent.

A/C Generator Trailer. The size and weight of the A/C supply cable demands the handler to be of above average strength and structure. The rear bumper extensions prove to be shin bruisers and serious tripping hazards.

All other areas and functions of trailer are easily and safely accessed.

2.4 RELIABILITY EVALUATION

2.4.1 Failures - Cause and Action Taken

The Trouble & Corrective Maintenance Report supports the Usage Log and is used to analyze degradation, failure rates, or trends. These data are entered daily by site personnel as problems occur and/or are reported. The data are used to:

- o Set work priority
- o Establish status of open items
- o Evaluate spares requirements
- o Analyze as part of the evaluation process.

Subsequent text explores the criticality of failures as reported in the trouble reports with respect to health care delivery. The following definitions apply:

Critical - A failure which directly impacts health care delivery capability or safety (e.g., Mobile Health Unit out of service).

Major - A failure or situation which seriously affects operation and/or cost, but does not affect a major portion of the system operation capability (e.g., computer failure).

Minor - Has no serious affect on operation or cost -- operation can continue via other modes (e.g., VHF back-up).

Examples

Case 1

Incident: No color video from MHU Exam Room camera. (Ref. Trouble Report 328, 29 Dec. 1975.)

Impact: Major.

Cause: Failure in color TV camera.

Corrective Action: Camera returned to vendor for repair.

Case 2

Incident: Minor leaks on the lower radiator hose of MHU. (Ref TR 377, 31 Jan. 1976.)

Impact: Minor with potential critical impact, i.e., MHU out of service.

Cause: Normal degradation.

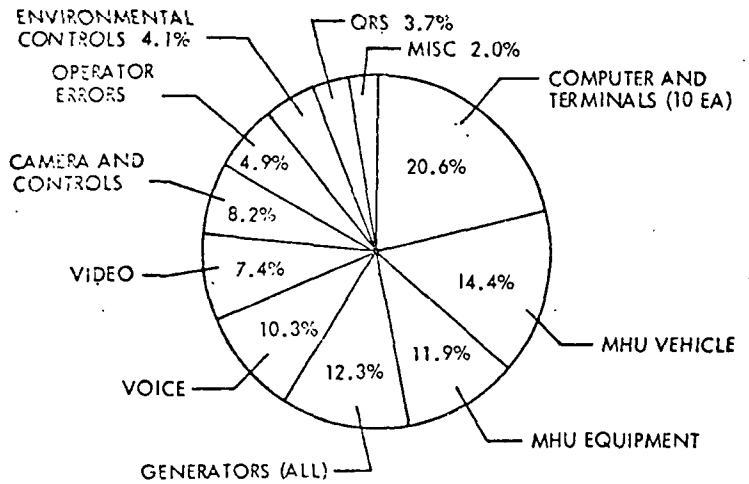
Corrective Action: Temporary patch made with rubber material. Permanent repair made using vulcanized patch.

2.4.2 Classification of Trouble Reports

Figures 2-15 and 2-16 illustrate another approach to analyzing system problems. It considers the "cause" of the problem. Figure 2-15 gives the comparison of trouble report distribution between the first and second 6-month periods. Figure 2-16 illustrates the trouble report analysis for the full 12-month period. Figure 2-17 considers the "effect" of the problem. Note that this latter treatment eliminates the category of "operator error". For example, in TR #319, the operator failed to plug in a heater. The "cause" is classified as "operator error" while the "effect" is classified as "environmental controls". While there is not a significant difference between the two techniques, the use of both constitutes a useful tool because it does allow a management view of operator error which reflects the need for additional training or enforcement of the use of checklists, etc. To continue this example further: in the first 6 months of operation, operator errors accounted for 4.9 percent of the trouble reports generated; in the second 6 months, they account for 4.5 percent. This reduction is statistically insignificant and would tend to indicate that this is the level at which operator errors will continue to occur. To reduce this category, analysis of each specific incident with appropriate corrective action would be required.

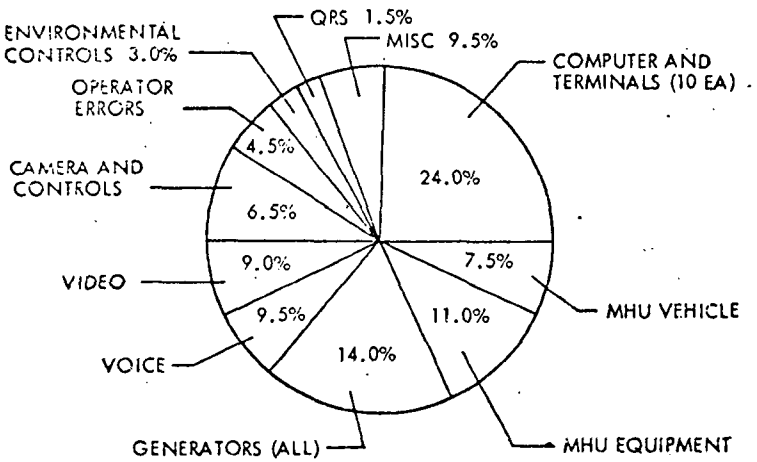
The "effects" technique reveals management data on groups of equipment which are causing the majority of the trouble reports and which operational functions are most affected. It may reveal, for example, that if we were to do it again, which areas would require upgrading equipments, eliminating equipments, and those groups which, because of their size/complexity, etc., require specialized training and sparing philosophy.

A comparison of the first 6-month operation to the second 6-month operation (Figure 2-15) indicates that the computer equipment group remains as the single high source of trouble reports.



MAY THROUGH OCTOBER 1975

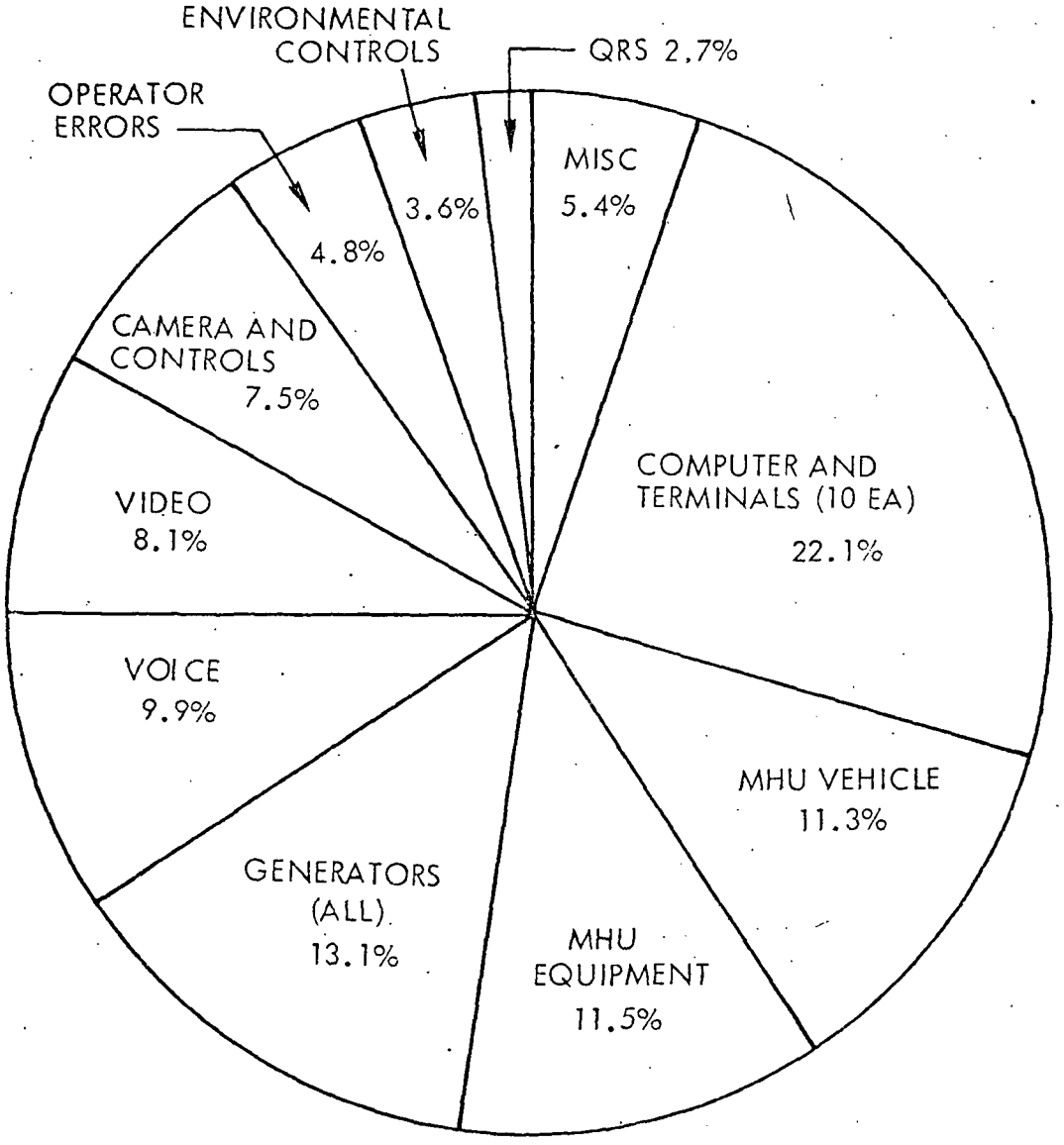
COMPUTER AND TERMINALS	50
MHU VEHICLE	35
MHU EQUIPMENT	29
GENERATORS (ALL)	30
VOICE	25
VIDEO	18
CAMERAS AND CONTROLS	20
OPERATOR ERRORS	12
ENVIRONMENTAL CONTROLS	10
QRS	9
MISC	5
TOTALS - TROUBLE REPORTS	243



NOVEMBER 1975 THROUGH APRIL 1976

COMPUTER AND TERMINALS	48
MHU VEHICLE	15
MHU EQUIPMENT	22
GENERATORS (ALL)	28
VOICE	19
VIDEO	18
CAMERAS AND CONTROLS	13
OPERATOR ERRORS	9
ENVIRONMENTAL CONTROLS	6
QRS	3
MISC	19
TOTALS - TROUBLE REPORTS	200

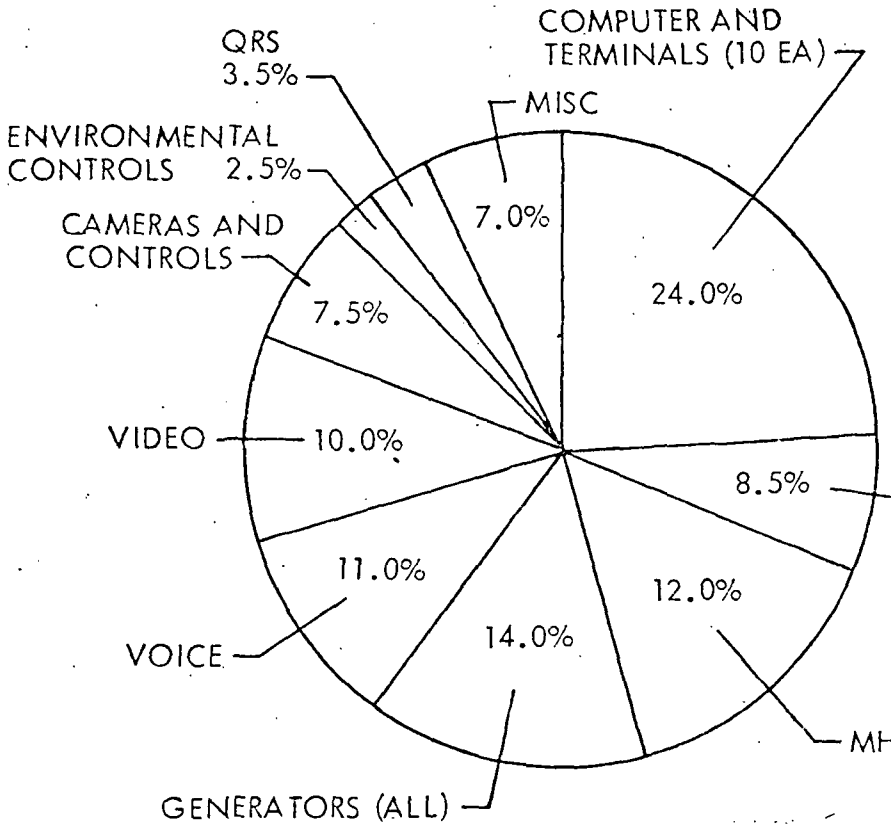
Fig. 2-15 Trouble Report Distribution (By Cause)
Two 6-Month Periods



COMPUTER AND TERMINALS	98
MHU VEHICLE	50
MHU EQUIPMENT	51
GENERATORS (ALL)	58
VOICE	44
VIDEO	36
CAMERAS AND CONTROLS	33
OPERATOR ERRORS	21
ENVIRONMENTAL CONTROLS	16
QRS	12
MISC	24
TOTALS - TROUBLE REPORTS	443

MAY 1975
THROUGH
APRIL 1976
(12 MONTHS DATA)

Fig. 2-16 Trouble Report Distribution (By Cause)
12-Month Period



COMPUTER AND TERMINALS	48
MHU VEHICLE	17
MHU EQUIPMENT	24
GENERATORS (ALL)	28
VOICE	22
VIDEO	20
CAMERAS AND CONTROLS	15
ENVIRONMENTAL CONTROLS	5
QRS	7
MISC	14
TOTALS	200

Fig. 2-17 Trouble Report Distribution (By Effect)

2.4.3 Failure Trend Analysis

Figure 2-18 defines the categories of trouble reports. For those specifically classified as failures, we see that all STARPAHC equipment experienced an average of 18 failures/month from November 1 to April 30, 1976, with a low of 14 failures in December and March, and a high of 26 in January. Although a sample size of 6 months is not statistically significant, the data presented in Fig. 2-18 are informative. For example, the number of total deficiencies in the second 6 months comes as a surprise because deficiencies would normally be expected to be initially high, decreasing and approaching zero. This reflects changing personnel, their interpretation of requirements, and in some cases, deficiencies or modifications made during the period.

Recording and tracking of failures proves valuable in predicting future trends or taking early corrective action to prevent future failures. In some cases, there are intermittent failures which give an indication of potential hard failure if not corrected. On a year's basis, the analysis is:

Average failures/month -- 21.9
Lowest failure months -- December 1975 and March 1976 with 14 Failures
Highest failure month -- August with 33 Failures

2.4.5 System Reliability

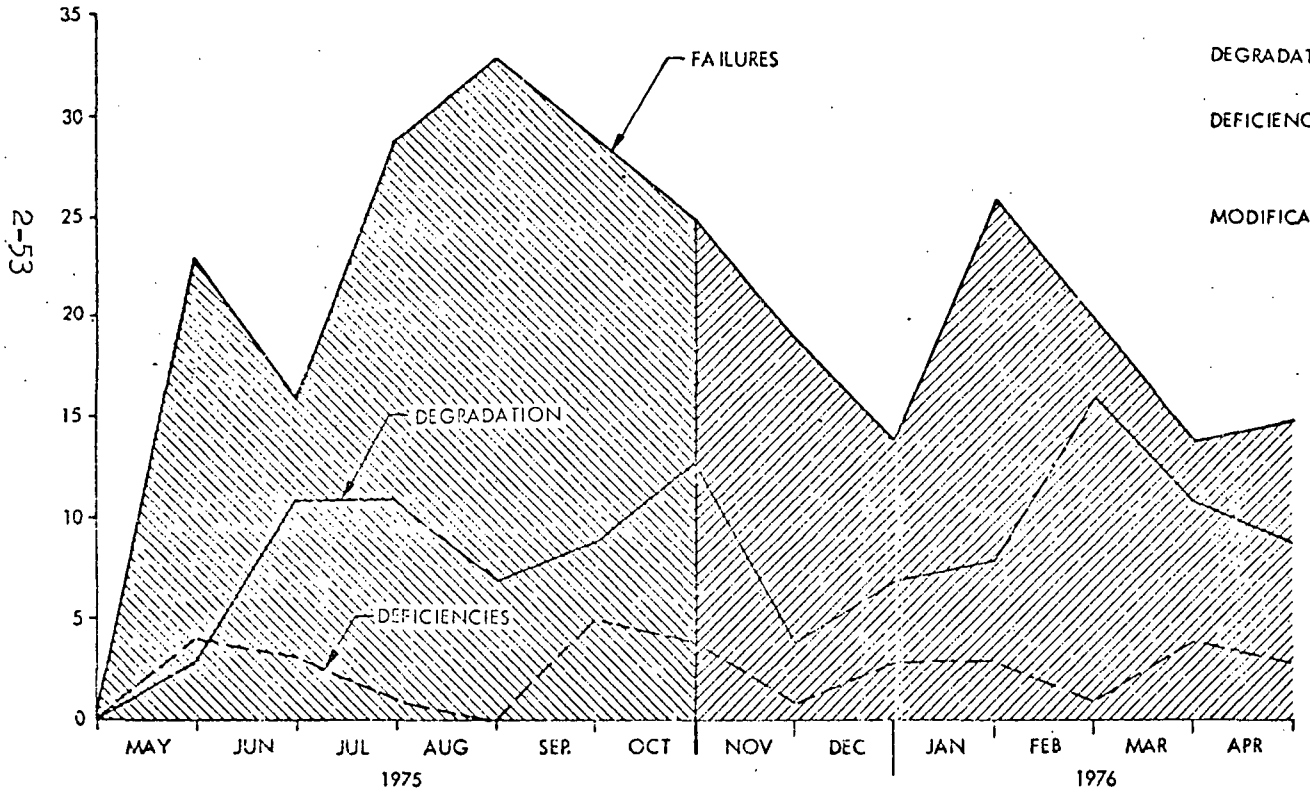
The TCE system reliability (defined as the probability of delivery of health care at any given time) of STARPAHC remains at a very impressive level of 0.984. This figure is derived from trouble report logs and the raw usage log which indicate that from 1 November 1975 to April 1976, only 33 "Not Acceptable" events occurred out of a possible 2022 events. In the 12-month period beginning on May 1, 1975, the reliability of the system is 0.981. As noted in the previous report, the TCE system reliability is actually higher because of redundant system capability, e.g., a "not acceptable" voice transmission via the Handsfree Intercom System is easily overcome by switching to either the Hotline or the VHF system(s).

INCIDENT CLASS	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
FAILURES	23	16	29	33	29	25	19	14	26	20	14	15	263
DEGRADATION	3	11	11	7	9	13	4	7	8	16	11	9	109
DEFICIENCIES	4	3	1	0	5	4	1	3	3	1	4	3	32
MODIFICATIONS	1	2	1	1	6	0	1	3	1	1	1	2	20
OTHER	0	1	2	2	1	0	2	4	2	1	2	2	19
TOTALS	31	33	44	43	50	42	27	31	40	39	32	31	443

1st PERIOD TOTAL = 243

2nd PERIOD TOTAL = 200

* MODIFICATIONS AND OTHER NOT PLOTTED.



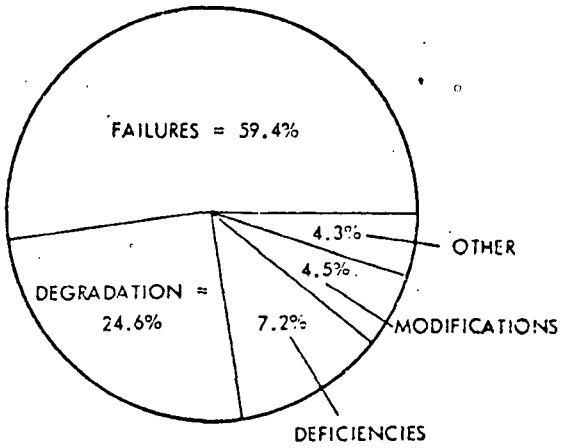
DEFINITIONS OF INCIDENT CLASSES

FAILURES – EQUIPMENT MALFUNCTION CAUSING INTERRUPTION OF SERVICE.

DEGRADATION – REDUCTION OF PERFORMANCE; HOWEVER, EQUIPMENT MAINTAINS OPERATION.

DEFICIENCIES – NO REDUCTION OF PERFORMANCE; HOWEVER, IMPROVEMENTS OR MODIFICATIONS ARE RECOMMENDED.

MODIFICATIONS – CHANGES TO EQUIPMENT THAT RESULT IN IMPROVED PERFORMANCE.



INCIDENT DISTRIBUTION – MAY 1975 THROUGH APRIL 1976

Fig. 2-18 Trouble Report Trend Analysis

Analysis of the 200 trouble reports since November 1 has generated the following comments:

1. The use of trouble reports for purposes of documentation or modification, removal of equipments for loan purposes, routine maintenance for degradation, etc., distorts the true failure rate because often there is no service interruption.
2. In some cases, a "failure" snowballs into several trouble reports, either because of the time required to solve the problem or because of lack of understanding of what is causing the problem. For example, equipment will be exercised while an open trouble report exists; thus resulting in writing a trouble report which duplicates the operator trouble report.
3. Many trouble reports have been classified as "failures" when in reality they were design deficiencies, operator error, or written against the wrong equipment. These reports were not cancelled or reclassified. Examples of these misclassifications include:

o TR 319 - 29 Nov. 1975	MHU heater would not operate; classified as a failure. Cause: unit unplugged - operator error.
TR 335 - 23 Dec. 1975	Replaced broken sensor (break-in alarm) at QRS; classified as a failure. Cause: broken upon forced entry.
o TR 328 - 29 Dec. 1975 and TR 240 - 2 Jan. 1976	Written against the same problem; TR 328 against color camera for no video output. Cause found to be the CCU per TR 240.
o TR 337 - 31 Dec. 1975	Lost sequence of operation between wind generator and Onan generator. Cause: wiring errors, misclassified as a failure.

Cancelling or reclassification of these types of trouble reports would significantly reduce those TRs classified as failures.

Section 3
MEDICAL EVALUATION RESULTS

3.1 UTILIZATION OF THE STARPAHC EQUIPPED FIELD FACILITIES

The Medical Evaluation Plan (Appendix B) has been implemented during both the first and second 6-month periods to achieve the goal of assessing the impact of STARPAHC on patient care. The second 6-month period (November 1975 through April 1976) saw an 18.5 percent increase in patient visits to the STARPAHC equipped field facilities (Health Center at Santa Rosa and Mobile Health Unit) compared to the first 6-month period (May through October 1975). Patient visits to the Mobile Health Unit (MHU) increased by 175 (10.9 percent). Visits to the health center at Santa Rosa increased by 553 (23.7 percent).

Table 3-1 illustrates the comparison between the two 6-month periods for the two STARPAHC facilities. The mean visits/day for the MHU showed an increase from 17.2 to 17.8 between the two 6-month periods, while the health center mean visits/day varied from 20.1 to 22.3 over the same two periods.

Figure 3-1 shows the monthly variation in patient visits during one year of operation. The first 6-month average STARPAHC patient visits were 555 compared to the second 6-month average of 776. An epidemic of influenza starting at the end of February through March and the increase in scheduled routine physical examination of school children accounted for some of the increase. The highest number of patient visits to the MHU and the Santa Rosa health center during the first 6-months occurred in October 1975 (716), mainly attributed to a large increase in patient visits to the health center at Santa Rosa. The average patient visits per month to Santa Rosa continued at a high level during the second 6-months (480 compared to 388 for the first 6-months), whereas the average patient visits per month to the MHU during the second 6-months were 296 compared to 267 for the first 6 months.

This section discusses the impact of health delivery by STARPAHC on the three western districts of the reservation, gives the utilization of telecommunications equipment by the health care providers, particularly voice and TV, and evaluates the quality of care provided by the STARPAHC facilities.

Table 3-1

PATIENT VISITS TO STARPAHC FACILITIES*

Evaluation Period	STARPAHC Equipped Facilities				Total Patient Visits
	Mobile Health Unit		Health Center at Santa Rosa		
	No. of Patient Visits	Mean Visits per Day	No. of Patient Visits	Mean Visits per Day	
First 6 Months	1,601	17.2	2,330	20.1	3,931
Second 6 Months	1,776	17.8	2,883	22.3	4,659
One-Year Total	3,377	17.5	5,213	21.3	8,590
Change in No. of Patient Visits (Second Over First 6 Months)	+175	–	+553	–	+728
Change in Percent of Patient Visits (Second over First 6 Months)	+10.9	+0.6	+23.7	+2.2	+18.5

*Data obtain from HIS printouts June 2, 1976. Dental Visits are excluded. Patient visits include all visitors on/off the reservation.

	1975								1976				
Facility	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Totals
Santa Rosa	393	331	431	340	374	461	368	446	490	539	540	500	5213
MHU	261	241	312	273	259	255	198	275	238	292	501	272	3377
Combined Tot.	654	572	743	613	633	716	566	721	728	831	1041	772	8590

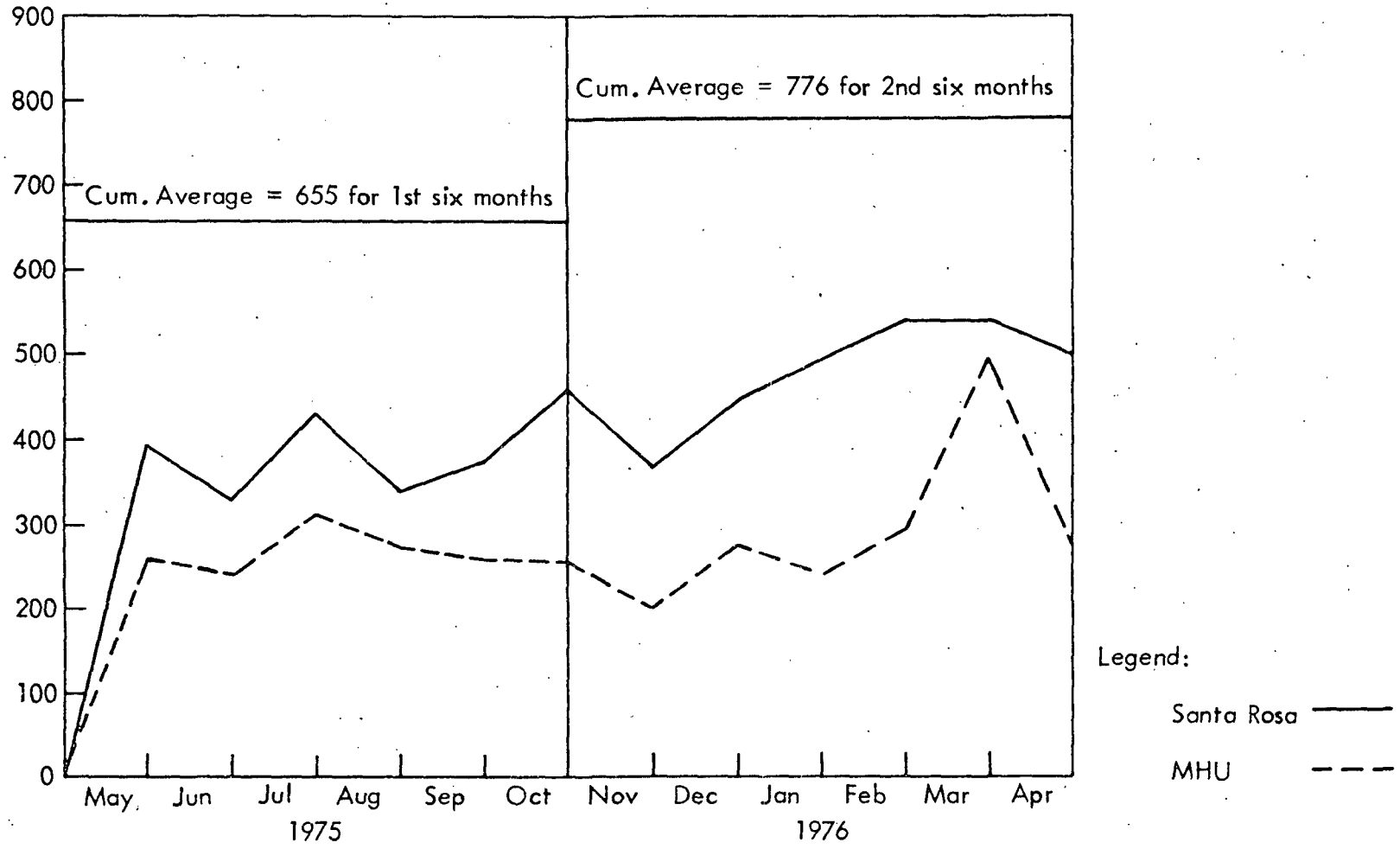


Fig. 3-1 Monthly Variation in Patient Visits to the two STARPAHC Facilities

3.1.1 Utilization of Health Services by District of Residence

Patient visits to elements of the Sells Service Unit, comprised of the Sells Outpatient Department, the Health Center at Santa Rosa, and the MHU, were analyzed on the basis of their district of residence. In other words, people who lived in one of the nine districts on the reservation could visit any of the health facilities comprising the Sells Service Unit or could even visit the San Xavier Clinic in Tucson.

IHS computer data (Health Information System) annotates for each patient visit their district of residence. A summary of these patient visits for the two 6-month periods furnished the basis for determining the utilization of health services. Data from San Xavier Outpatient Department was also reviewed to see the effect of patient visits from the nine districts. Two other categories of patient visits were also included: (1) Off-Reservation Patient Visits, e.g., patients from Ajo and Tucson, and (2) Unknown Districts, e.g., insufficient information.

Since one of the goals of the STARPAHC Project is to increase health services to the western district, the analysis of visits by district of residence served by the Santa Rosa Health Center, the MHU and the Sells Hospital Outpatient Department is shown on Table 3-2.

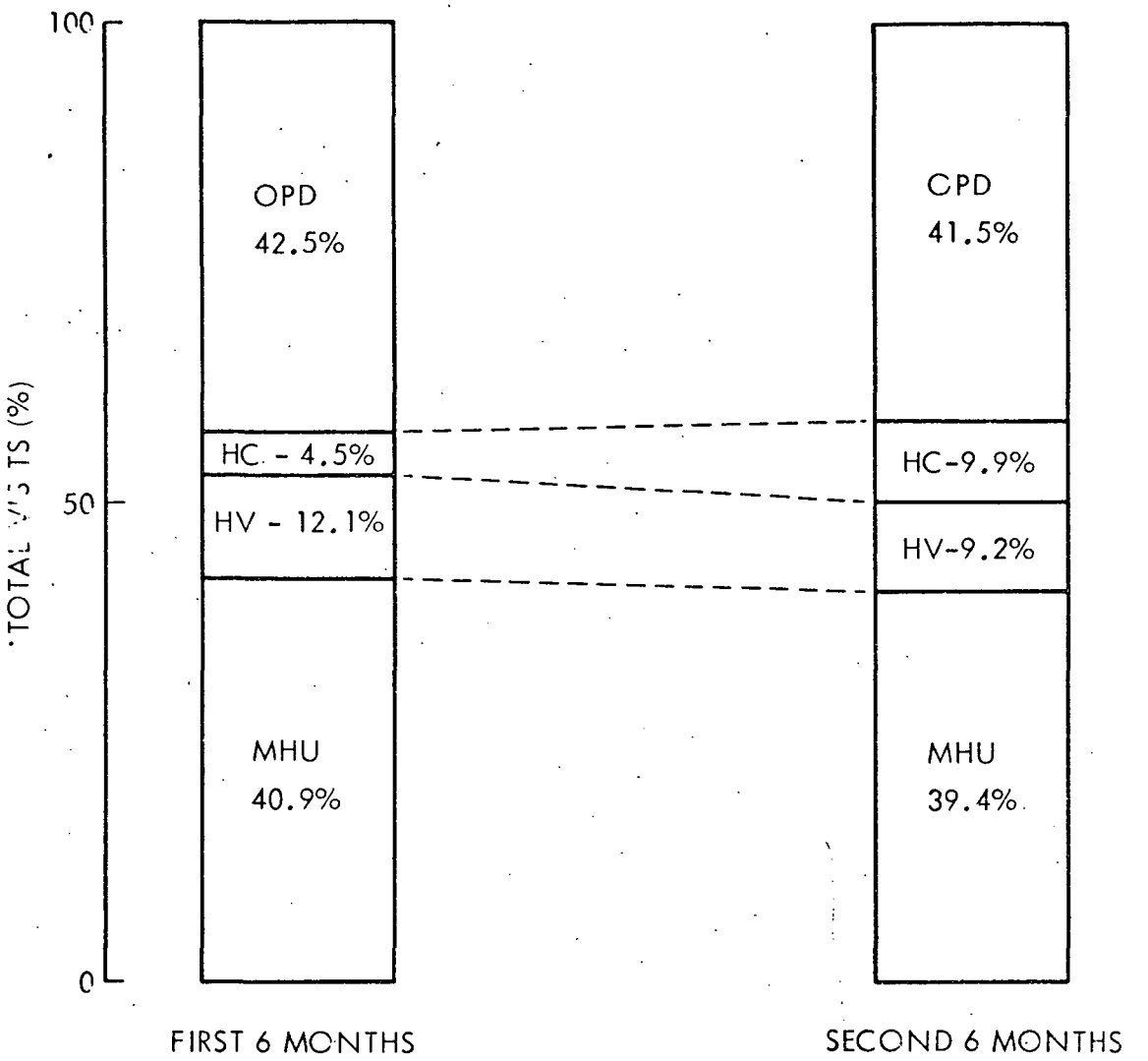
For the three western districts served by the MHU (Pisinimo, Gu Vo and Hickiwan), there has been a significant increase in patient visits during the second 6-months as compared to the first 6-months (3280 to 3834). Comparison of the effect of health service in the northern districts (Gu Achi and Sif Oidak) served by Santa Rosa Health Center, over the two 6-month periods shows again a significant increase during the second 6-months (3982 vs 3664).

For the three western districts mentioned above, Fig. 3-2 indicates percent of patient use of the health services by facility including the home visits. A significant increase in the second 6-month visits of 13 percent is noted in total visits to the four places listed in Fig. 3-2. A significant switch is also noted in the increase in patient visits to the Santa Rosa health center at 5.4 percent. This increase could be also attributed to the flu epidemic.

Table 3-2

PATIENT VISIT RATIOS BY POPULATION

Study Group	Districts	Population Estimate	First 6 Months		Second 6 Months		Change in No. of Patient Visits (Second Over First 6 Months)	Change in Percent of Patient Visits (Second Over First 6 Months)
			Patient Visits	Patient Visit Ratio	Patient Visits	Patient Visit Ratio		
A. Health Center at Santa Rosa	Gu Achi Sif Oidak	1,845	3,664	1.99	3,982	2.16	+318	+8.7
B. Mobile Health Unit (MHU)	Pisinimo Gu Vo Hickiwan	1,591	3,280	2.06	3,834	2.41	+554	+16.9
C. Sells Hospital Outpatient Department (OPD)								
Area 1	Sells	2,660	6,941	2.61	7,668	2.88	+727	+10.5
Area 2	Baboquivari Chukut Kuk Schuk Toak	1,656	3,383	2.04	3,502	2.11	+119	+3.5
Totals	9	7,752	17,268	2.23	18,986	2.45	+1,718	+9.9



HEALTH SERVICES	EVALUATION PERIOD	
	FIRST 6 MONTHS	SECOND 6 MONTHS
SELLS OUTPATIENT DEPARTMENT (OPD)	1569	1732
SANTA ROSA HEALTH CENTER (HC)	167	415
HOME VISITS (HV)	448	383
MOBILE HEALTH UNIT (MHU)	1510	1647
TOTAL	3694	4177

Fig. 3-2 Change in Site of Health Service - Western Districts

3.2 UTILIZATION OF STARPAHC TELECOMMUNICATIONS

Table 3-3 and Figure 3-3 summarizes the use of any portion of the STARPAHC communication systems for any purpose relative to specific patients, including clinical consultations. This Table is constructed by counting all the individual patients for whom the field staff contacted any department at the Sells Hospital using STARPAHC communications equipment. All components of telecommunications equipment used for the same patient on the same day are counted as one patient consultation. One patient consultation could, therefore, use a number of STARPAHC telecommunication components ranging from one (i.e., the hot line) to twenty-two (i.e., MUX, VHF, microwave, and slow scan TV, etc.). However, the range is more often from one to eight.

The number of patient consultations has risen 12.7 percent in the second 6-months compared with the first 6-months. The increase has been mostly at the Health Center (+34.2 percent)as compared with the mobile unit (+7.1 percent). However, the percent of patient visits where the field health providers thought a remote consultation was necessary, dropped slightly (-0.6 percent) during the second 6-months for the mobile unit. The relative percent usage by the health center also decreased slightly (-0.3 percent). This relative drop is probably due to the fact that about 230 routine school physicals were done since January (90 percent at the health center). Healthy school children probably are not as likely candidates for a remote consultation as the general ambulatory care population. Also, the mobile unit had a particularly heavy patient load during March because of influenza. Most of these visits were probably diagnosed as an "upper respiratory infection" and consultation was not indicated.

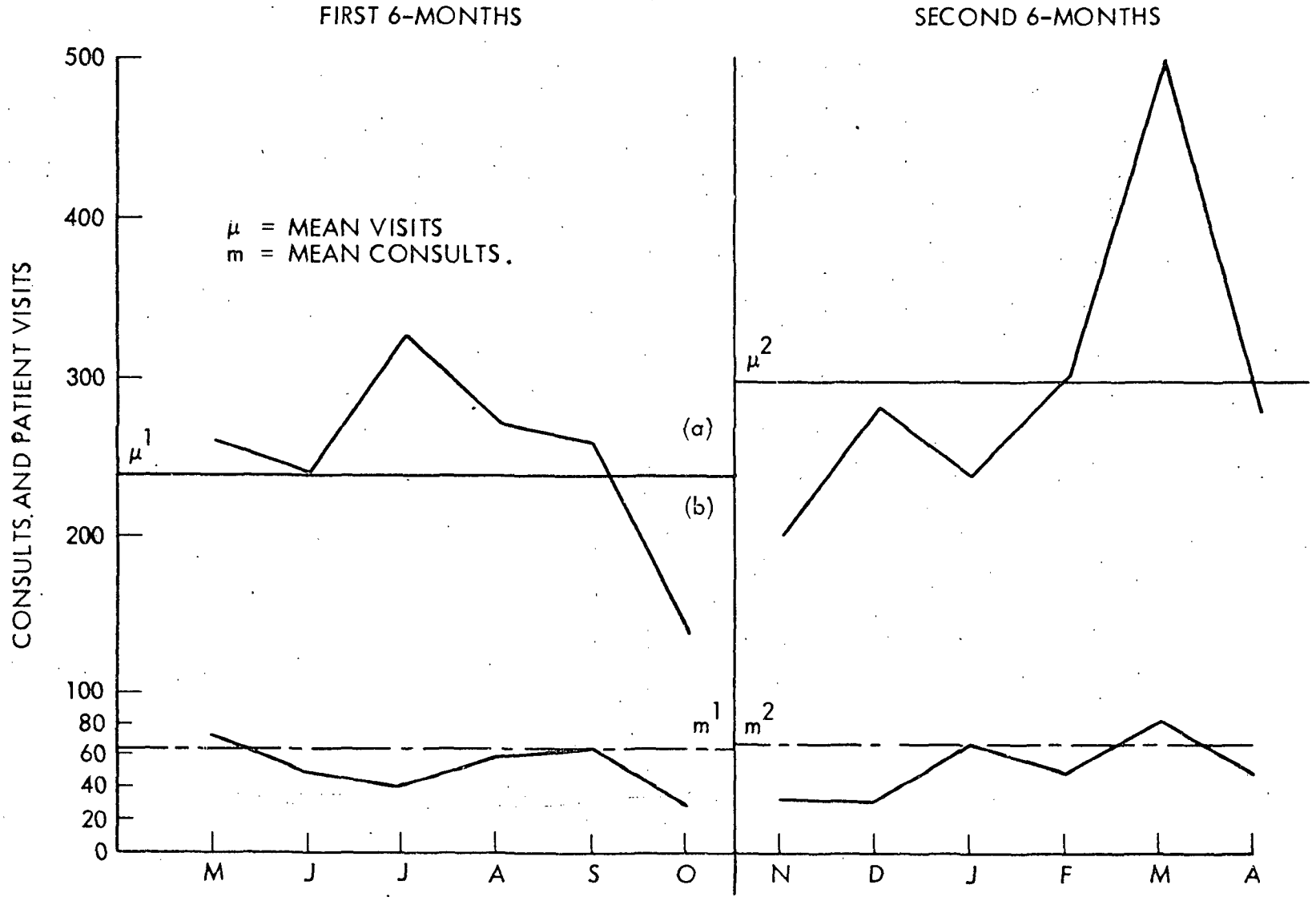
The percent of total patient visits to the health center for which remote STARPAHC consultations were held has remained lower than for the mobile clinic; 3.5 percent compared with 18.9 percent for the 12-month period. (See Table 3-3). This difference is explained by the fact that the health center has telephones and is not completely dependent upon the equipment furnished by the project. In addition, the use of the voice communication equipment by the mobile clinic always increases when the Varian STARPAHC computer fails, while the health center's use of data is not affected. The center uses a direct telephone data link to the IBM computer in Tucson.

Table 3-3

UTILIZATION OF STARPAHC EQUIPMENT FOR PATIENT CONSULTATION FROM THE FIELD TO SELLS

(All Modes of Consultation)

Evaluation Period	Site						Total Both Sites		
	Mobile Clinic			Health Center					
	Visits	Consults.	%	Visits	Consults.	%	Visits	Consults.	%
First 6-Months	1,601	308	19.2	2,330	79	3.4	3,931	387	9.8
Second 6-Months	1,776	330	18.6	2,883	106	3.7	4,659	436	9.4
One Year Total	3,377	638	18.9	5,213	185	3.5	8,590	823	9.6
Change in No. of Patient Visits	+175	+22		+553	+27			+49	
Change in Percent of Patient Visits	+10.9	+7.1	-0.6	+23.7	+34.2	+0.3		+12.7	-0.4



(a) Total Field Visits (MHU + Traveleze Trailer Outfitted with Voice/Digital Capability)
(b) Visits to MHU only.

Fig. 3-3 Patient Visits to the MHU and Consultations to Sells Hospital

3.2.1 Utilization of Television by the Field Staff

The different patterns of STARPAHC communication usage between the mobile and health center is shown in Table 3-4.

The use of television components has been singled out for detailed study because of the higher costs of operation as compared with other STARPAHC components, such as the VHF radio system. One of the objectives of the evaluation was to discover the extent of the use of televised remote consultations needed to support an ambulatory care program in a rural area. It must be recognized that the CHM's are well trained, confident in their own ability, and not particularly anxious to seek direction from M.D.'s at Sells unless, in their judgment, the case clearly warrants such direction.

Table 3-4 indicates that television consultations occurred only for 3 percent of patient visits to either site, for either time periods. Staff changes for the mobile and fixed clinics occurred almost every month, yet the use of television for clinical support has not varied greatly.

Table 3-5 gives the patient consultations by purpose and use of television by site for each of the 12 months.

The monthly range of use of TV by site is shown below:

Study Periods	Monthly Range of Use of T.V. for Clinical Consultation as Percent of Patient Visits	
	Mobile Clinic	Health Center
First 6-Months	0.8% to 6.6%	0.9% to 5.6%
Second 6-Months	0.8% to 6.2%	1.9% to 5.1%

During the first 6-months, the highest use of television for clinical support occurred during August and September as a result of a direct order from the Service Unit Director to the CHM's. They were required to use the equipment for at least five consults per day. This goal was not achieved, but increased usage did occur (5.1% and 6.6% of all patient visits to the mobile clinic; 5.3% and 5.6% of all patient visits to the health center). For the remaining 10 months, almost all televised patient consultations from the field by the CHMs was the result of their perceived need for help in diagnosis and/or treatment.

Table 3-4

USE OF TELEVISION FOR CLINICAL CONSULTATION BETWEEN MEDICS AND PHYSICIANS BY SITE*

Evaluation Period	Mobile Clinic					Health Center				
	Visits	Patient Consults.	Clinical Consultations Using TV			Visits	Patient Consults.	Clinical Consultations Using TV		
			No.	Consult. (%)	Visits (%)			No.	Consults (%)	Visits (%)
First 6 Months	1,601	308	49	15.9	3.1	2,330	79	63	79.7	2.7
Second 6 Months	1,776	330	51	15.5	2.9	2,883	106	95	89.6	3.3
One-Year Totals	3,377	638	100	15.7	3.0	5,213	185	158	85.4	3.0

*Data from the system operator's logs plus IHS evaluation forms

Table 3-5

PATIENT CONSULTATIONS BY PURPOSE AND USE OF TELEVISION BY SITE

Evaluation Month	MHU			MHU TV Consults as a Percent of Patient Visits	Health Center (HC)			HC TV Consults as a Percent of Patient Visits
	Patient Visits	All Consults	TV Consults		Patient Visits	All Consults	TV Consults	
First 6 Months								
May	261	74	5	1.92	393	12	5	1.27
June	241	46	2	0.83	331	3	3	0.91
July	312	39	6	1.92	431	11	8	1.86
Aug	273	58	14	5.13	340	21	19	5.26
Sep	259	63	17	6.56	374	21	18	5.56
Oct	255	28	5	1.96	461	12	10	2.17
First 6 Months Total	1601	308	49	3.06	2330	79	63	2.70
Second 6 Months								
Nov	198	39	5	2.53	368	18	15	4.08
Dec	275	34	4	1.45	446	15	14	3.14
Jan	238	69	2	0.84	490	28	26	5.31
Feb	292	48	18	6.16	539	13	10	1.86
Mar	501	84	14	2.79	540	14	13	2.41
Apr	272	56	8	2.94	500	18	17	3.40
Second 6 Months Total	1776	330	51	2.87	2883	106	95	3.30

The highest months for the second 6-month period seem to represent a random variation related to types of clinical problems presented to the medics. There was no correlation of utilizations of television based upon staffing of the clinics. The highest consultation rate at Santa Rosa (January, 5.3 percent) occurred during the month when the regular CHM was replaced by a physician for 8 of 21 work days. The CHM initiated all the TV consults (26) during the remaining 13 days. The highest use of televised consults on the mobile unit occurred in February (18 or 6.2 percent), when the regular CHM was on duty.

3.3 PERCEIVED VALUE OF TELECONSULTATIONS

This section summarizes data from the special evaluation forms filled out by the health staff following a consultation. Table 3-6 shows the value judgments of the CHM sender compared with the M.D. receivers for each of the two 6-month periods. Ninety-five percent of all evaluation forms received contained a value judgment. However, for 202 (or 24.6 percent of all consultations known to have occurred from the system operator's logs), no evaluation forms were filled out by IHS staff. In the table, 433 out of the 487 consultations have been rated by the CHM and MDs as having a "positive" value (89 percent) ("Critical for the proper care of patients and important or useful").

The physicians alone have consistently rated the value of remote consultations lower than have the CHMs (and all other health providers) for both 6-month periods. Negative consults (i.e., "of little or no value" plus "confusing or harmful") were rated as 25 percent of all M.D. consultations by physicians and only 2.6 percent by CHMs for the 12-month period.

There was little difference in the relative frequency of "positive" and "negative" judgments by the CHMs for the two periods. However, the "negative" judgments by the physicians increased from 23 percent in the first 6-months to 28 percent in the second 6-months. This rise may be spurious because the number of consultations for which IHS staff has been willing to provide evaluation data dropped from 83 percent in the first 6-months to only 68 percent in the second 6-months. The physicians may have completed forms with only negative evaluations more often than for consultations they considered of positive value.

Table 3-6

PERCEIVED VALUE OF TELECONSULTATIONS BY SENDER (CHM) AND RECEIVER (MD)*

Value of Each Consult	Health Providers								Total Year CHM + MD	
	CHM Sender				MD Receiver					
	First 6 Months		Second 6 Months		First 6 Months		Second 6 Months			
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Critical for the proper care of patient	35	24.5	17	10.4	6	6.6	5	5.6	63	12.9
2. Important or useful	102	71.3	144	88.3	64	70.3	60	66.7	370	76.0
3. Of little or no value	6	4.2	2	1.3	18	19.8	21	23.3	47	9.7
4. Confusing or harmful	0	0	0	0	3	3.3	4	4.4	7	1.4
Totals	143	100.0	163	100.0	91	100.0	90	100.0	487	100.0
Total Forms Received	157		165		95		94		511	
Total Answered	143		163		91		90		487	
Percent Answer	91.1		98.8		95.8		95.7		95.3	

*CHM – Community Health Medic in Field
MD – Physician at the Sells Hospital

3.3.1 Perceived Value of Television From the Field

Physicians rated television consultations as 65 percent "positive", and 35 percent "negative". Almost all the "negative" value judgments by physicians about remote consults have been concerning patients for whom the CHM in the field initiated a televised consult. All consults were initiated for "help in the diagnosis or treatment of the patient's problem". A few had additional reasons given, such as for "help in confirmation of my (the CHM) first impression".

In the first 6-months, most of the "negative" judgment about consultations by physicians were due to the enforced initiation of televised consults by the former service unit director. However, in the second 6-months, most were correlated with failure of the television systems to perform as expected. However, for certain consultations where the systems operator had noted that the television was "good" or "excellent", physicians noted the following separate comments on their evaluation reports: They were unable to diagnose skin rashes, especially those with papules less than 3 mm. in diameter; celluitis, lymphangitis, and details of skin lacerations when the color television was used. The problem seems to be their difficulty in seeing shades of red upon a dark-skinned patient. This problem may be due to inadequate lighting in the mobile clinic or health center, inadequate ability to focus the camera or perhaps the inherent ability of the color system has been exceeded.

On two consultations, the physicians were unable to diagnose a transmitted x-ray. In both cases, the original film was properly processed and was later read as "negative". When the distribution of value judgments were analyzed by individual physicians, it was seen that most of the "negative" judgments had been made by two physicians who were among the three most frequent receivers for each evaluation. One physician accounted for about 33 percent of all "negative" judgments for each evaluation period. Data presented in this report should be interpreted with this fact clearly in mind.

3.4 FAILURE RATIOS FOR CONSULTATIONS

The ratios in Table 3-7 were calculated by counting all those patient consultations where any health staff member indicated any communications system "failure" or the quality of the system was checked as "poor". These ratios cannot be compared to the Performance Acceptability Ratios (PARs) reported in Section 2, since Section 2 is restricted to hardware element performance and these failure rates are with respect to accommodating consultations. Therefore, PAR for medical evaluation represents a go/no-go teleconsultation performance.

In addition, the users may, at times, have indicated a "failure" because their needs or expectations were not satisfied, while in the system operator's judgment, the system in question was functioning properly.

The number of failures is related to the percent of patient consultations for which IHS health staff returned one or more evaluation forms. No data was received for 17 percent of known consultations in the first study period, and 32 percent in the second. Ninety-five percent of this 32 percent was for hot line consultations between the nurse or CHM on the mobile unit and the medical records laboratory and pharmacy offices. The staff may report only those times when a failure occurred. Therefore, the true failure rate for voice communications is most likely much lower than the 14 percent tabulated. On the other hand, 96 percent of all television consultations have been reported by the health staff, so these rates are more likely correct.

The "other" systems in Table 3-7 include the use of cardiostethoscope, ECG, X-ray transmission via black and white TV, black and white TV transmission from Sells to the field, and the Varian data system. Although the Varian computer experienced numerous failures during both 6-month periods, the health staff rarely utilized their evaluation forms to register these failures.

Table 3-7

CONSULTATION FAILURES NOTED BY HEALTH PROVIDERS BY COMMUNICATION SYSTEM

Evaluation Period	Voice		Video-Color		Other		Total	
	No. of Failures	Failure* Ratio	No. of Failures	Failure Ratio	No. of Failures	Failure Ratio	No. of Failures	Failure Ratio
First 6 Months No. of Consults 366	30	15.2	30	22.7	9	24.3	69	18.9
Second 6 Months No. of Consults 283	22	13.9	23	20.9	5	33.3	50	17.7

*Failure Ratio $= \left(\frac{\text{No. of Failures}}{\text{Type of Consults}}\right) 100$

Note: Data Source – HIS Evaluation Forms Only

3.5 QUALITY OF CARE

The quality of care computerized monitoring programs developed by the Indian Health Service with the assistance of the Bureau for Health Services Research, HSA (EMCRO Project - Experimental Medical Care Review Organization), are now being used to evaluate the STARPAHC facilities. We are especially interested in whether the mobile clinic, with its time and space restrictions, can deliver a quality of care at least equal to the health center. Both are staffed with Community Health Medics, assisted by licensed practical nurses. Both remote facilities are also being compared with the quality of health care rendered by physicians at the hospital outpatient department.

The following are a few examples of results for a few conditions during one 6-months time period (July 1 through December 31, 1975).

A complete description of the Methodology for quality care assessment can be found in a paper by Shorr, Nutting, and Berg: "Quality Appraisal of Ambulatory Patient Care: An Eclectic Approach", June 1975. (Available from the Office of Research and Development, IHS, Tucson, Arizona).

3.5.1 Hypertension Screening, Contact, and Drug Coverage Rates

The following table refers to patient visits during the period of July - December, 1975, to four facilities, and the quality of care received determined by the number and type of procedural steps provided the patient for diagnosis and treatment.

	FACILITY			
CRITERIA	Sells OPD	San Xavier Health Ctr.	Santa Rosa Health Ctr.	Mobile Health Unit
Population eligible for screening	4780	2390	976	123
Percent eligible population screened	59.8	71.3	55.7	82.9
Number active hypertensive patients	224	44	40	23
Percent active hypertensive patients seen	85.3	84.1	75.0	95.7
Percent active hypertensive patients with 5-month supply of prescribed medication	16.2	14.0	8.8	20.0

The first column lists the population (ranging from 4780 at Sells to 123 at the MHU) which are eligible for screening (over 10 years old, no previous diagnosis of hypertension). The second column gives the percent of the eligible population screened. It is noted that the MHU rates highest (82.9 percent), followed by the San Xavier Health Center at 71.3 percent. The third column lists the total number of active hypertensive patients being cared for at the various facilities. The fourth column gives the percent of active hypertensive patients seen (for any reason) during this 6-month period. The fifth and last column gives the percent of active hypertensive patients who have been prescribed sufficient medication to cover them for at least 5 months of the 6-month period.

The Mobile Health Unit ranks highest in percentage of quality of care in all categories listed for hypertension screening, contact, and drug coverage. The quality of care delivered during an active hypertensive patient's visit to the MHU or to the Santa Rosa Health Center was assessed by determining the number and types of procedural steps provided the patient for diagnosis and treatment.

The following table refers to the known hypertensive visits (for any cause) to one of the two facilities and the quality of care received during the visit. The procedural steps are categorized as recording blood pressures, notation of the hypertension problem on the patient's record, and treatment for hypertension.

CRITERIA	FACILITY	
	Mobile Health Unit	Santa Rosa Health Ctr.
Number, known hypertensive patients' visits (1st group)	63	101
Percentage, visits when blood pressure was recorded	44.4	39.6
Number, known hypertensive patients' visits (2nd group)	47	71
Percentage, visits when hypertensive problem was noted on the patients' record	68.1	64.8
Number, known hypertensive patients' visits (3rd group)	46	68
Percentage, visits when patients received treatment for hypertension	73.9	52.9

The Mobile Health Unit again ranks highest in all the percentages for the Quality of Care parameters examined.

3.5.2 Quality of Care for Gastroenteritis

The following table refers to patient visits to two facilities (Mobile Health Unit and Santa Rosa Health Center) and the quality of care received for Gastroenteritis determined by the number and type of procedural steps provided the patient for diagnosis and treatment. The procedural steps are categorized as: notation on the patient's record and proper treatment.

CRITERIA	FACILITY	
	Mobile Health Unit	Santa Rosa Health Ctr.
Number, patients' visits (1st group)	19	37
Percentage, visits when the degree of seriousness (stage) was also stated	73.7	2.7
Number, patients' visits (2nd group)	35	55
Percentage, visits when all pertinent data was recorded	71.4	72.7
Number, patients' visits (3rd group)	15	26
Percentage, visits when fluid therapy was recorded for those indicated by stage of disease and age	60.0	69.2
Number, patients' visits (4th group)	35	56
Percentage, visits when indicated treatment by age and stage was given	94.3	96.4

The MHU is competitive with the Santa Rosa Health Center in the Quality of Care associated with visits for Gastroenteritis.

From the above preliminary data, it appears that the quality of health care provided by the Mobile Health Unit is competitive with or better than the care delivered at other facilities.

3.6 OPINIONS OF HEALTH STAFF

The following is a brief summary of a detailed study about the opinions of the health providers regarding the STARPAHC Project. All data was collected by an experienced behavioral scientist who is not a member of the local agency, i.e., the Office of Research and Development, IHS, Tucson, Arizona. The data was collected by a specially designed questionnaire administered through quarterly interviews with the health providers involved with the project. The interviewer does not have access to other evaluation data prior to each session.

3.6.1 Staff Changes in the Sells Service Unit

During the first 6-month period, physicians who participated in consultations turned over 68 percent (i.e., of the six physicians related to the project in May, four had been replaced in August). Two physicians have remained through the entire 12 months. These two physicians participated in about 50 percent of all CHM/MD consultations in the first 6-months, and 25 percent during the second 6-months. No physicians changed during the second 6-months.

Three CHMs worked in the mobile unit during the first 6-months. Of these, one continued to work during the second 6-months except for a short duration when replaced by a new CHM in April. One physician worked 4 days on the mobile unit with the CHM in January and March while routine physical examinations were given to school children.

CHMs at the Santa Rosa Clinic during the first 6-months changed three times. One of these has transferred to the mobile unit in September, and remained there almost continuously since. During the second 6-months, two CHMs were assigned to the health center, one almost continuously. Physicians substituted 29 days for CHMs during the second 6-months (18 percent of work days), and for 19 days during the first 6-months (16 percent of work days). Nursing and driver/interpreter support for both sites, and both 6-months remained almost constant.

Of prime importance for the smooth operation of the project was the rapid turnover of the physicians in the position of Service Unit Director. Two changes occurred in the first 6-months. There was no full-time director during the second 6-months. A new director has now been assigned.

The provider questionnaire was asked of 15 IHS staff people in April 1976. This included all physicians at Sells (eight) including the acting SUD; three CHMs; two health records people; one nurse on the MHU; and one physical therapist. Everybody except one CHM had been interviewed at least once before and several people had been interviewed all four times. (Four physicians had been interviewed two times before; four physicians had been interviewed three times before).

3.6.2 Results of April Interviews

In response to a question on whether or not the provider gets enough clinical information from the teleconsultation to substitute for a face-to-face encounter, four physicians and one CHM said no for the following reasons:

- medicine is still an art and not a science.
- quality of the picture and sound are limited.
- depends too much on the CHM.
- if patients are seriously ill, the physician wants to see them in person anyway.

No one felt that STARPAHC provides more information than is needed.

There were, however, four people who said that the use of STARPAHC teleconsultations were critical to the patient; three people spoke about a child that was treated on the MHU for a high fever and conjested chest, and one person with a broken bone.

One physician felt that the teleconsultation was harmful in that it took too much time from other duties.

Only three people said there are some negative effects of STARPAHC; two said that the time involved in setting up and getting ready for a consultation was a negative thing.

Note: As in the last questionnaire in November 1975, all providers said they had changed patient treatment plans because of a teleconsultation.

Three providers said that because of STARPAHC, they have changed their way of treating patients, now with STARPAHC they are more cautious.

The only educational value was seen mainly for the CHM who have an opportunity to learn about medical practice with each consultation and by one physician who thinks the idea of having an interesting case on video tape to look at when he has spare time could be educational to him.

3.6.3 Opinions Regarding the Use of Television

Eight providers felt that TV was important to have over voice alone in order to see patient attitudes, faces, pain, skin lesions, X-ray, and EKG, while four providers, three MDs and one CHM, said voice alone could have handled all of the consultations they had.

As with other prior interviews, the staff agreed that the data (HIS), voice, and the MHU are the most important parts of STARPAHC and should be given high priority in determining which parts of the system to keep. Black and white TV was ranked over color from the field to the hospital, while TV to the field from the hospital was ranked low.

The providers split as to whether it is important for patients to see them over the TV. The equipment considered most useful to the providers was the data (HIS) and voice, while TV from the field was considered to be sometimes useful.

Only four providers (all physicians) felt that slow scan could replace live TV pictures now being used, while the four other physicians and two CHMs said seeing movement, reflex, pain, etc., is important and only live TV pictures with motion can accomplish this.

3.6.4 Major Benefits and Problems

The major benefits as described by providers included as before, the following:

- patients have better access (12 of the 15 providers mentioned this).
- decrease in patient travel.
- people getting care early.
- better data system for patients which makes it easier to get appointments and records in field.

The major problems seem to be connected with the time required for consultation and time away from "other important duties." In the MHU, it was felt that in the time it took for one TV consultation, four people could have been seen by the CHM and that, therefore, the more TV consultation the less people have access to the CHM's limited time. The Varian computer is not working many times, causing problems. The MHU is too small and sometimes patient privacy is a problem. Some providers said the cost is too high and that is a problem. The picture and color are not always good enough. STARPAHC is not set up like a medical system twenty-four hours a day, it is more like an experiment and therefore was considered a problem for one provider.

The providers in all surveys to date felt that quality of care was the number one area to be evaluated by STARPAHC. That was followed by cost, use of care, time saved by patient and patient acceptance in that order, as other areas that were important to evaluate in STARPAHC.

No provider was apprehensive about using the TV and other STARPAHC equipment.

Only three physicians said "STARPAHC would not be successful because costs are too high vs benefits", or "the location is not made for STARPAHC since transportation is available; maybe if tested in another more isolated site, it would be more successful". Five providers didn't know if it would be successful because "the bad and good things are equal" and "things should work better to really judge", or as one person puts it, "people who evaluate STARPAHC have a stake in making it work" and he doesn't think "they would bring out the failures".

Seven providers felt STARPAHC will or is successful because "the Papago are positive towards it" or "because it provides better communication", "gets care to people in their villages", and "someone felt people running it have too much invested for it not to succeed".

3.6.5 Results of Opinions for Each Study Period Compared

In general, the results are very similar to before with both positive and negative attitudes. Providers still have problems with equipment failure and making time for consultation, but they appreciate the fact that Papago people are getting better access to care due primarily to the MHU.

3.7 EVALUATION OF THE MOBILE HEALTH UNIT SERVICE

A detailed description of the field operations of the MHU was carried out by ORD evaluation staff for one week in March. (See Appendix D for the detailed description). The following is a brief summary of the results.

3.7.1 Patient Waiting and Services Times in a Mobile Clinic

The average daily patient visits (27) for the observational week was 50 percent higher than the average patient visits for the second 6-months (18.0), and slightly higher than the average daily visits for the month of March (25.5). Table 3-8 gives a summary of patient waiting and service times for the MHU during the week of March 22-25.

A general comparison can be made between the mobile clinic and other one-physician stationary clinics in the Indian Health Service which have been studied. The nursing service time (this is primarily a screening and preparatory function) is slightly longer than that observed at Taholah, Washington, or Roosevelt, Utah. Waiting time to see the primary care provider is less than that at Taholah but more than Roosevelt. On the mobile clinic, the CHM was not only the primary provider on call, he was also the pharmacist and the X-ray and laboratory technician. However, this circumstance could be balanced by the fact that patients who use the mobile clinic are referred to Sells where a more detailed work-up is required. The average service time for the CHM was comparable to physician service times elsewhere in the Indian Health Service. Although most

Table 3-8

AVERAGE WAITING AND SERVICE TIMES* PER PATIENT, MOBILE HEALTH UNIT, MARCH 22-25, 1976

Periods	Monday Pisinimo	Tuesday GuVo	Wednesday Hickiwan	Thursday Kaka	Daily Average	Number of Persons Going Through This Point
Time elapsed from signing in until called by nurse	35.7	38.3	37.0	11.0	30.5	87
Nursing service time	7.2	4.0	5.6	3.7	5.1	87
Waiting time to see CHM	9.6	7.8	4.4	5.0	6.7	88
CHM service time	11.1	6.9	10.1	9.3	9.4	90
Number of patients observed	24	38	19	13	27	–

*Times are in minutes. All patients did not go through each station.

patients could be seen at the mobile clinic within one hour, the ratio of total (nurse + CHM) service time to waiting time was roughly 1:2. The bulk of waiting times occurred between sign-in and being called by the nurse. This is not surprising since about one-fourth of the patients arrived in groups in the bus or carry-all, and others came as families -- especially mothers with several children.

3.7.2 Telecommunications by Type and Purpose from the MHU

Telecommunications from the mobile clinic during the observational week are shown in Table 3-9. The effect of the data system failure is seen for day 2 and 3 when remote consultations were above average for the month: 22.4 percent of patient visits for the week compared with 16.8 percent of visits for the month. The consultation rate for clinical use of television, 2.1 percent, was below the monthly rate of 2.8 percent.

3.8 EVALUATION OF SLOW SCAN TELEVISION

The last link of the STARPAHC Project was completed on February 19, 1976, when the slow scan television system linked the Sells hospital to the referral center at the Phoenix Indian Hospital.

A method for initiating TV consults from Sells was developed in February. Testing of the new link was started in March.

One hundred eight pictures of patients and X-rays were sent to Phoenix over a period of 10 days. Only 4 transmissions had to be repeated because of severe noise distortion on three different days. All used dial-up telephone service for transmission.

Included in the 108 transmissions were 6 X-ray films of a special nature. They were taken at the Optical Science Center, University of Arizona and contained a hidden "coin" lesion superimposed upon a chest film of a model.

The iris control and zoom lens feature of the system permitted detection of the lesion in all cases.

Table 3-9

TELECOMMUNICATIONS ABOUT PATIENTS FROM THE MOBILE CLINIC BY TYPE AND PURPOSE DURING THE OBSERVATION PERIOD

Purpose: M = Medical Administration C = Clinical Consultation

Type of Telecommunication	Number of Patients						Totals	
	Voice Alone		Voice Plus Return TV		Voice Plus 2-Way TV		No. Consults	% of Visits
Purpose	M	C	M	C	M	C		
Day Site (No. of Visits)								
1. Pisinimo (24)	3	1	1	0	0	0	5	20.8
2. GuVo[1] (38)	2	0	6	0	1	0	9	23.7
3. Hickiwan[1] (19)	4	1	0	0	0	0	5	26.3
4. KaKa (13)	0	0	0	0	0	2[2]	2	15.4
Totals (94)	9	2	7	0	1	2	21	22.3

(1) Computer providing medical data not functioning for days 2 and 3.

(2) Includes transmission of a chest x-ray. Patient subsequently sent to Sells Hospital.

Research studies by experienced radiologists are providing data about the reliability of reading X-ray films compared with reading the television images from the storage disc and video tape recorder.

Nine patient consultations via the slow scan link occurred in April. In two of these, the Phoenix radiologist read the transmitted X-ray image differently than the Sells physician. A revised diagnosis resulted. After the radiologist explained the abnormal patterns observed on the television monitor, the Sells physician concurred on the changed diagnosis. The other seven X-ray image readings in Phoenix confirmed diagnoses of the Sells physician.

These nine consultations are in addition to those reported in other sections of this report.

3.9 PRELIMINARY ANALYSIS OF PATIENT ACCEPTANCE OF THE MHU

3.9.1 Methods

This report presents the findings of a pre-test of a questionnaire asked of Papago patients using the Mobile Health Unit, a major component of the STARPAHC project. The final questionnaire and sample design are being revised so that the Papago tribal health workers will be able to judge the acceptance of this sophisticated medical care delivery system by the Papago people. The sample design, it is hoped, will provide at least a 10 percent sample of TV users on the MHU and a broader sample of all Mobile Health users.

The Mobile Health Unit visits four sites each week and is re-supplied the fifth day. The four sites are Pisinimo, Hickiwan, Kaka, and Gu Vo. In the pre-test, a total of 33 people were interviewed; ten at Gu Vo in September 1975, nine at Hickiwan in September 1975, nine at Pisinimo in January 1976, and five at Kaka also in January 1976.

The interviews were done by a member of the Papago Executive Health Staff in Papago.

3.9.2 Results

In general, the results of the pre-test were very favorable. No one reported not liking the service and only two people expressed any negative attitude about the service and this relating to the fact that transportation to the MHU is sometimes a problem. Several people felt that it was much easier to get routinely required medication from the MHU and that it was nice to have health care available so close to home and that they did not have to go to the Sells Hospital anywhere from 40 to 100 miles away.

Most people feel that their questions were answered properly and that the care provided by the staff was very good. There was a case of one person not really understanding his problem and why he was sent to Sells Hospital, but most people felt good about the explanation provided by the staff.

When asked if they were given a second chance would they prefer to go to another facility, 29 said they like the MHU care where it is now; only three people would have preferred Sells Hospital and one preferred the old Pisinimo Clinic.

Of the total sample in the pre-test, 17 people had used the MHU 2-5 times; 3 people used it 6-10 times; and 10 people came when needed; only 3 people were there for the first time.

Time spent at the MHU for most patients was not long; 29 said they were seen in a short time, 3 people had to wait awhile, and only one said they spent a long time at the MHU. When asked how long it took the patient to get seen and back home, 27 people said not long at all, five said awhile but not a long time, and one said it depends on transportation availability after being seen.

The patients were asked what they did not like about the MHU; 27 people said everything was all right, no problems; one didn't know; and five mentioned the following things they didn't like:

The MHU was small.
Drivers didn't pick up patients.
If you're not signed up by 3 P.M., you don't get seen.

When asked if the MHU was ever late, only five people said yes.

In this small pre-test, only seven people had any of the special equipment used on them; four went on T.V., one had an X-ray, one had an EKG, and one didn't mention what was used.

Most of the people, 31, felt that the staff's attitude was good; only two people said staff attitude was not good.

Other general comments by individuals included such statements as:

- She didn't like the idea of a man (MHU driver) present while being asked personal questions about women problems.
- Felt the CHR should go house-to-house to find people who need to get to MHU.
- Driver didn't pick up patients.
- Doors need to be closed when examining women.
- Team staff is very busy.
- Computer not working and patient had to go to Sells.
- Wanted dental care at MHU but had to go to Sells.

These results show that there are very few problems with patient acceptance of the MHU and STARPAHC equipment.

Section 4

COST ANALYSIS

4.1 STARPAHC COSTS

This presentation of STARPAHC costs includes:

Recurring Costs for operations and maintenance including labor, parts, expendables, subcontracts, utilities, and transportation.

Nonrecurring Costs for (a) capital equipment and (b) system improvements including engineering, labor, consumables, and installation costs.

Specifically excluded from this cost analysis are the general costs of project planning, development, management, and evaluation.

4.2 RECURRING COSTS

The recurring operations and maintenance costs of the involved agencies are described as follows. See Table 4-1 and Figure 4-1 for cost distribution by agency.

Indian Health Services costs include medical support to the STARPAHC system, medical operation of a fixed base and mobile clinic, health records, pharmacy, lab and X-ray services, transportation, maintenance of buildings and grounds, and related field administration.

Lockheed site costs cover field operations and maintenance of the STARPAHC system hardware including the central control point at Sells, the Relay Station, the Mobile Unit, the fixed facility at Santa Rosa, and the Phoenix Indian Hospital referral site.

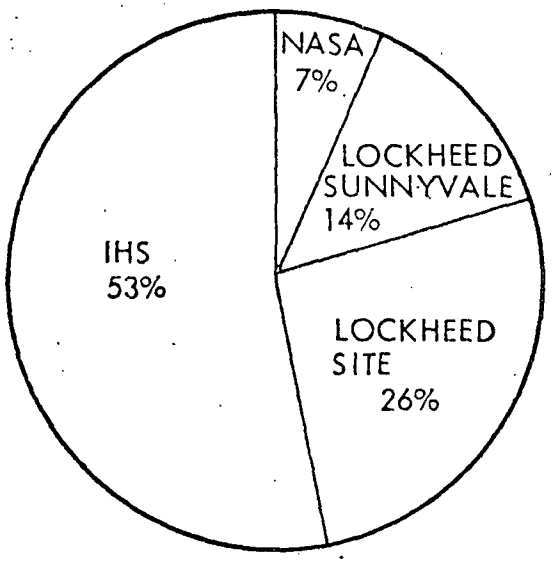
Lockheed costs at Sunnyvale cover engineering support required to resolve field operational problems.

NASA costs include a maintenance contract for the Varian computer and the cost of vehicles furnished to Lockheed employees at the site.

Table 4-1

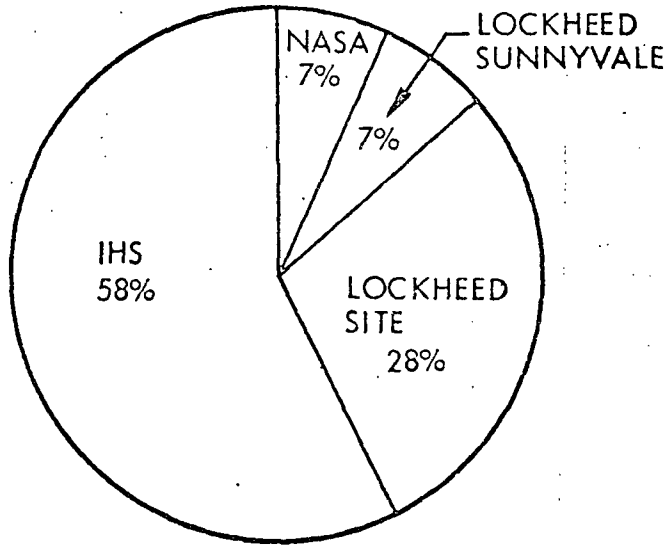
RECURRING COSTS OF OPERATIONS AND MAINTENANCE
DISTRIBUTION BY MONTH AND BY AGENCY
FIRST YEAR OF STARPAHC OPERATIONS

	AGENCY				
		Lockheed			
	IHS	Site	Sunnyvale	NASA	Total
May	$ 24,316	$ 9,672	$ 11,866	$ 2,400	$ 48,254
June	16,990	7,325	2,420	2,400	29,135
July	18,212	10,291	9,894	2,400	40,797
August	17,562	6,928	1,230	2,400	28,120
September	17,961	8,768	3,571	2,400	32,700
October	17,541	11,432	1,941	2,400	33,314
First 6-Mo. Total	$112,582	54,416	30,922	14,400	212,320
November	$ 18,196	11,839	4,876	2,400	37,311
December	18,351	8,537	585	2,400	29,873
January	18,882	8,616	3,748	2,400	33,646
February	20,088	10,195	779	2,400	33,462
March	20,799	6,215	1,826	2,400	31,240
April	18,980	10,282	1,778	2,400	33,440
Second 6-Mo. Total	$115,296	55,684	13,592	14,400	198,972
Annual Total	$227,878	$110,100	$44,514	$28,800	$411,292



MAY THROUGH OCTOBER 1975

Agency	Cost
IHS	$112,582
LOCKHEED SITE	$ 54,416
LOCKHEED SUNNYVALE	$ 30,922
NASA	$ 14,400
TOTAL	$212,320



NOVEMBER 1975 THROUGH APRIL 1976

Agency	Cost
IHS	$115,296
LOCKHEED SITE	$ 55,684
LOCKHEED SUNNYVALE	$ 13,592
NASA	$ 14,400
TOTAL	$198,972

Fig. 4-1 Recurring Cost of Operations and Maintenance
(Distr. by Agency)

Operations and maintenance costs are tracked monthly as incurred by each agency with details by major system element and by subsystems.

Cost trends appear to be stabilizing with a 6-percent decrease for the second 6-month operational period as compared with the first 6-month operational period. The number of patient visits during the second 6-month period showed an increase of 4 percent. See Table 4-1 and Figure 4-2 for recurring costs of operation and maintenance by month for the first year of STARPAHC operations.

4.3 NONRECURRING COSTS

The nonrecurring costs incurred by the involved agencies are briefly described as follows. See Table 4-2 for cost distribution by agency and by equipment systems.

Indian Health Service costs include data terminals and improvements to buildings and sites.

Lockheed and NASA costs include installed telecommunications equipment and mobile vehicles. Also shown are costs of improvements to systems subsequent to start of operations, the chief expenditure being for backup power and other modifications to the data system.

Excluded are developmental costs, mockups, and other similar costs.

Capital equipment costs and significant system improvements are amortized over a ten-year period, without interest. Ten-year amortization has been chosen based on the anticipated life of major system equipments.

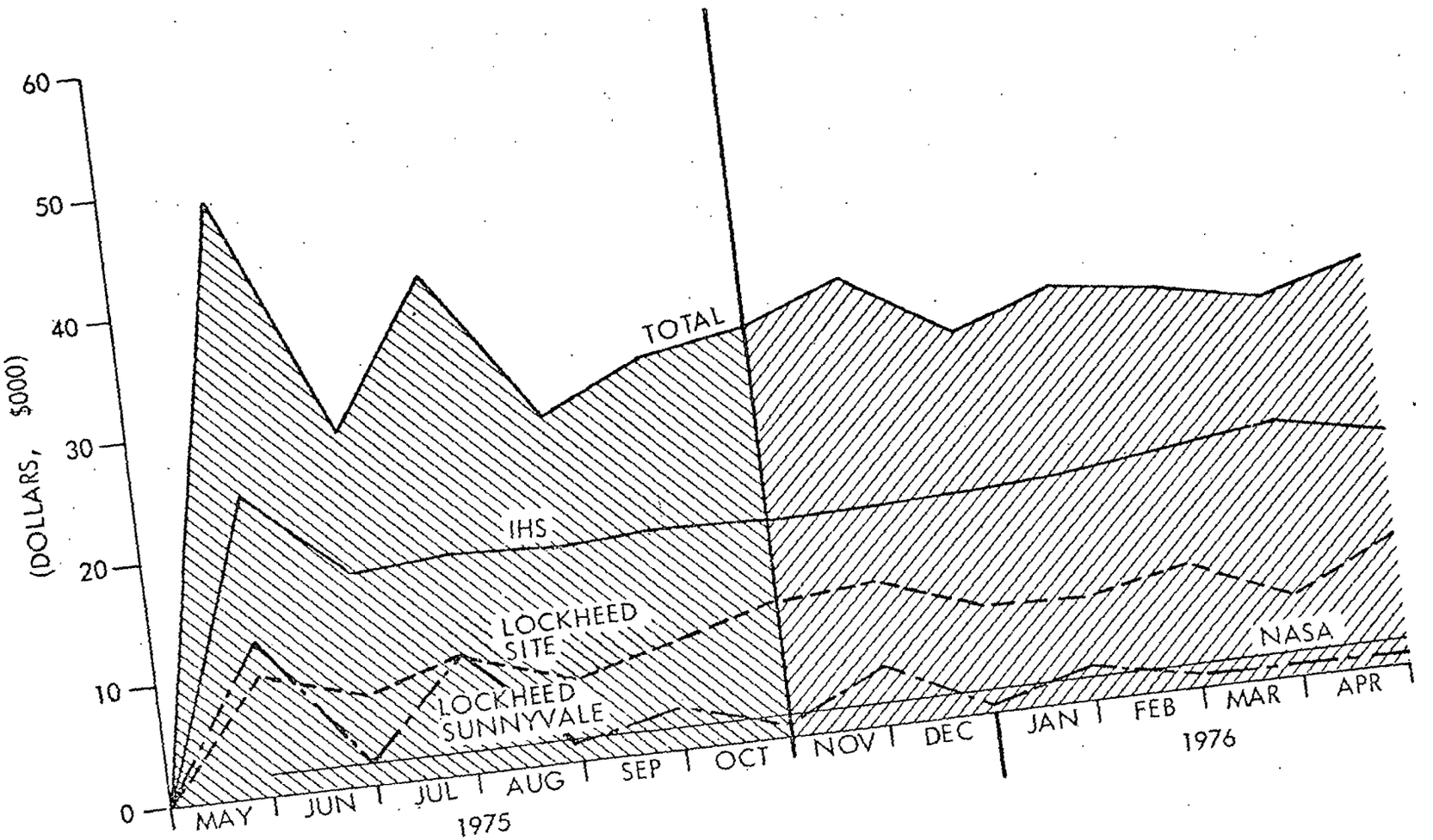


Fig. 4-2 Recurring Cost of Operations and Maintenance (Distr. by Agency/Month)

Table 4-2

NONRECURRING COSTS

Installed Equipment and System Improvements Showing Amortization Rates

	Installed Equipment ($)	System Improvements ($)	Total ($)	Amortizati- Each 6 Mo ($)
Indian Health Service				
Data System	10,265	--	10,265	513
Building and Site Improvements	40,729	--	40,729	2,037
Total IHS	50,994	--	50,994	2,550
Lockheed and NASA				
VHF Radio	10,235	--	10,235	512
Color TV	205,014	--	205,014	10,250
B&W TV	112,159	--	112,159	5,608
MUX, TV Audio	130,031	--	130,031	6,502
Slo-Scan	72,363	--	72,363	3,618
Data System	163,366	27,503	190,869	9,543
Control System	29,079	1,032	30,111	1,506
Antenna and Supporting Structures	26,089	--	26,089	1,304
Engineering and Maintenance (Non-T.C.)	--	3,039	3,039	152
Diagnostic and Treatment Equipment	74,033	--	74,033	3,702
Vehicle	132,365	4,234	136,599	6,830
Total Lockheed and NASA	954,734	35,808	990,542	49,527

4.4 UNIT COST CONSIDERATIONS

In developing unit costs under Project STARPAHC, several options are available. These include:

4.4.1 Cost Per Outpatient (OP)

This includes the cost of treating each outpatient visit, whether or not the telecommunications system was used for each outpatient. Outpatients involved are those at the Mobile Health Unit and the Santa Rosa Clinic.

Note that the cost per outpatient is related directly to an end product of the Indian Health Service. It is also flexible, allowing for comparisons between different kinds of facilities.

4.4.2 Cost per Telecommunications Equipment Usage

This may be treated as the cost of one TV or communications usage for any piece of equipment. It may also be subdivided into data system usage, TV system usage, and communication system usage. This analysis is in an early state.

4.4.3 Cost per Hour of Operation

An alternative method of analysis which may be of limited specialized use to telecommunication planners would be cost per hour of the various systems. This analysis is also in an early state.

4.4.4 Cost per Telecommunication Usage and per Hour of Operation

The cost per telecommunication usage and the cost per hour of available operation may be applied in given situations, but it does not permit the multiple comparisons possible with the cost per outpatient.

In this One Year Interim Report, unit costs per outpatient are presented as they are the most meaningful at this time. Future evaluation reports will contain alternate unit cost comparisons as discussed above.

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An alternative method of analysis which may be of limited specialized use to telecommunication planners would be cost per hour of the various systems. This analysis is also in an early state.

4.4.4 Cost per Telecommunication Usage

This cost per hour of available operation may be applied in given situations, but it does not permit the multiple comparisons possible with the cost per outpatient.

In this One Year Interim Report, unit costs per outpatient are presented as they are the most meaningful at this time. Future evaluation reports will contain alternate unit cost comparisons as discussed above.

4.5 COST PER OUTPATIENT (See Table 4-3 and Figure 4-3)

This analysis relates the number of patient visits to costs. Two alternatives are provided for costs per outpatient; the first is based on recurring operations and maintenance costs only and the second is based on a consolidation of recurring and nonrecurring costs.

4.5.1 Recurring Operating and Maintenance Costs Per Outpatient Visit

Project STARPAHC recurring operating and maintenance costs (the sum of all agencies, Lockheed, NASA, IHS) shows a 21-percent reduction during the second 6-month operating period. This reflects a net increase in the number of patient visits and a cost decrease.

	First 6 Mo.	Second 6 Mo.	Change
Recurring O&M Cost per O.P.	$54.01	$42.71	-21%

4.5.2 Costs Per Outpatient Consolidated for Recurring and Nonrecurring Costs

For this analysis, the summation of recurring operating and maintenance costs of all involved agencies (4.5.1) and the nonrecurring capital costs of installed equipment and related system improvements, amortized over 10 years, is covered. The decrease of 18 percent in overall costs per outpatient results from a reduction in recurring costs and increased patient volume.

	First 6 Mo.	Second 6 Mo.	Change
Recurring and Amortized Nonrecurring Cost per O.P.	$65.63	$53.88	-18%

The difference between this reduction of 18 percent and the reduction of 21 percent in recurring costs per outpatient, above, is directly attributable to additional expenses for procurement of slow scan equipment and the system improvements that were in effect during the second 6-month period.

Table 4-3

COST PER OUTPATIENT

By 6-Month Operating Period and for First Year

	1st 6 Mo.	2nd 6 Mo.	1 Year
Recurring Operating and Maintenance Costs - All Agencies			
Number O.P.'s	3,931	4,659	8,590
Agency Cost			
IHS	$ 112,582	$ 115,296	$ 227,878
Lockheed Site	54,416	55,684	110,100
Lockheed-Sunnyvale	30,922	13,592	44,514
NASA	14,400	14,400	28,800
Total Cost	$ 212,320	$ 198,972	$ 411,292
Cost per O.P.	$ 54.01	$ 42.71	$ 47.88
Recurring Operating and Maintenance Costs Plus Equipment Amortization			
Number O.P.'s	3,931	4,659	8,590
Operating Cost	$ 212,320	$ 198,972	$ 411,292
Equipment Amortization Incl. Systems Improvement			
IHS	$ 2,550	$ 2,550	$ 5,100
Lockheed and NASA	43,127	49,527	92,654
Total Cost	$ 257,997	$ 251,049	$ 509,046
Cost per O.P.	$ 65.63	$ 53.88	$ 59.26

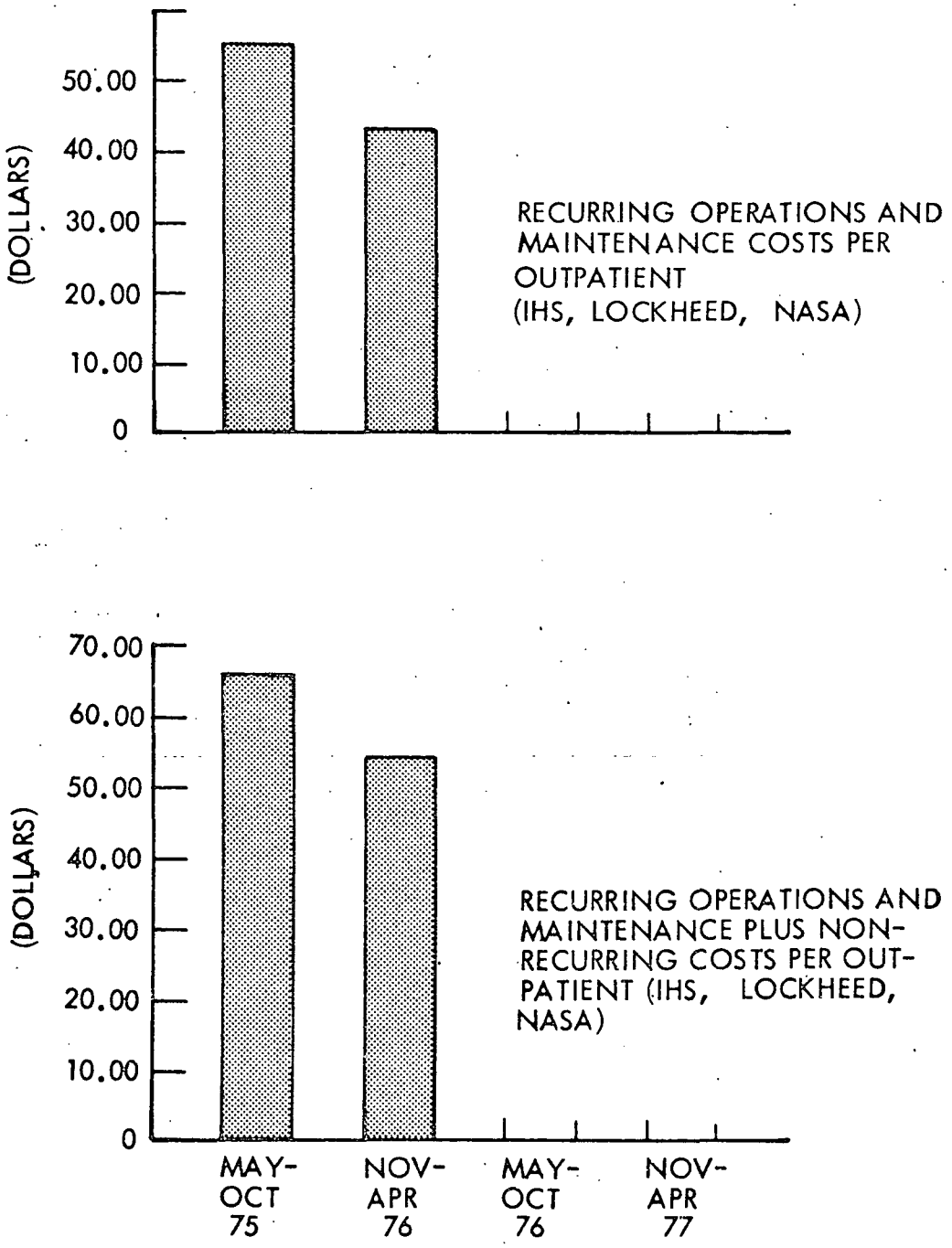

Fig. 4-3 Cost Per Outpatient By 6-Month Operating Period

To properly interpret the significance of cost per outpatient, one must consider other hypothetical applications of STARPAHC where the Mobile Health Unit and the Santa Rosa clinic would be operated either on a longer schedule, e.g., two-shift basis, or the patient density would increase significantly. In the former application, there would be additional costs associated with the salaries of the operating personnel whereas in the second application, there would not be any cost increase. In both applications, one could expect to see a significant reduction in the cost per outpatient. In view of these potential operational changes, one must carefully assess the environment that the system operates in and recognize that the cost per outpatient is directly proportional to the number of outpatient visits, which can vary widely dependent on the application of the system.

Section 5

CONCLUSIONS

The second 6-months of operation demonstrated a stabilized system that showed distinct improvements in reducing the number of equipment troubles, personnel proficiency as evidenced by the increase in number of telecommunications but a reduction in transmission time, number of patients treated/diagnosed, hardware day-to-day operations which were implemented by spares acquisition, and turn-around on repair.

User acceptance has been outstanding, as evidenced by a progressive increase in user dependence on key system elements and functions.

Community (patient) acceptance has been excellent and is directly attributable to the thorough orientations provided well in advance of system operations by the Papago Executive Health Staff to the Papago people in the towns and villages throughout the reservation.

Results of the preliminary cost analysis indicate that, on a cost/outpatient comparison, the system appears competitive, particularly if full consideration is given to the extensive logistic support involved in a remote environment.

Operational experience and data to date support the following conclusions:

- The STARPAHC concept is an effective, realistic way to administer quality health care to people in remote areas.
- Physician direction has been effective in diagnosing and/or treating patients by telemedicine. TV capability has been reported as important in many of the teleconsultation contacts.
- Performance Acceptability Ratio of 98.4 percent for the second 6-month period has demonstrated a reasonably dependable and maintainable system.
- The installation of the Uninterruptable Power Supply and the recent Varian repairs should result in increased reliability of the STARPAHC computer system. This increased reliability should also result in increased utilization of the system.

- The new operational procedures for the Active Medications function of the STARPAHC computer system is expected to result in increased utilization.
- Computer utilization for this evaluation has shown 89 percent usage directly attributed to patient health care.

APPENDIXES

Appendix A

MAJOR PROBLEM AREAS AND REMEDIAL ACTION TAKEN

Major problems during the past 6-month period occurred in the following areas:

- o Computer Hardware/Software/Terminals
- o QRS Rotatable Antenna
- o Wind Driven Generator (WDG)

This section will discuss the nature of the problem, probable causes, and corrective action taken.

A.1 Computer Hardware/Software/Terminals (See Glossary of Terms)

The computer hardware/software system operated satisfactorily in November and December with minor software problems that did not impact the operational usage. During this period, the standby diesel generator at Sells was used frequently which precludes the problems previously attributed to the utility sources.

Starting in January, difficulties were reported with the computer operation. Diagnostic and troubleshooting were initiated; the computer was operated intermittently to allow users access to certain programs that could be accessed successfully. Many problems were found such as defective memory board, read only memories (ROM) on the Data Communications Multiplexer board, transistors, regulator and power supply. After repair, the computer ran well during the last week in January. The first week of February showed a recurrence of problems necessitating another visit by the Varian personnel. A series of failures was observed, including the Diablo Disc running with crashed heads.

Intermittent operation continued through February, climaxing with a visit by Varian personnel in the second week of March to effect a thorough investigation and repair. The major problem was attributed to insufficient wire sizes in the power supply. A temporary repair was carried out to get the system operating, and new cables were fabricated and subsequently installed.

On the evening of April 14, there were high winds, snow, and hail at Sells. The diesel generator was in operation; however, its fly belt separated which caused overheating and shut down. The utility power was then switched on. Because of inclement weather, there were large fluctuations in the utility system power source which resulted in failure of components on two Printed Circuit boards on the computer. The failures were identified by LMSC personnel who notified Varian. Varian service personnel replaced the boards on April 20. The computer has operated satisfactorily to date.

A.1.1 Computer Hardware

Table A-1 provides a summary of statistical data on the Varian 73 (from 28 April 1975 through 15 March 1976). The first column identifies the statistical items, the second column lists the operational data where the computer system was down 100 percent. The third column gives operational data on computer failures which did not prevent the system from operating.

A.1.2 Computer Software

There were 29 trouble reports filed showing software failures or changes for the period of 1 May 1975 through 1 May 1976. Twenty-one of these failures are directly attributed to the installation of the new system in August 1975. There are currently four trouble reports open, and they do not significantly affect the operation of the system. Several trouble reports for Aeroneutronic Ford (ANF) software were cleared by LMSC when a partial delivery of documentation occurred.

Seven of the above failures caused the system to fail. Restart was accomplished by rebooting a fresh system. Eighteen failures were program errors and programs were inoperable until a fix was found. Four of the failures had little or no impact on the operation.

Table A-1

COMPUTER HARDWARE STATISTICS

Statistics	Computer Hardware (System 100% Down)	Computer Hardware (System Not Down)
Total Number of Failures	26	4
Total Operating Time in Hours	2252	NA
Total Down Time in Hours	250	187
Mean Time Between Failures (MTBF) in Hours	86.6	495
Mean Time to Repair (MTTR) in Hours	9.2	46.75
Total Number of Service Calls	13	NA
Time Between Service Calls in Hours	173	NA
Failures Repaired by Lockheed	9	NA

A.1.3 Terminals

Lockheed's technician maintains the seven remote data terminals at Sells Hospital, two at Santa Rosa, two in the MHU, as well as the two terminals located in the Physician's Room and the Operator's Room (total of 13 terminals).

The CDI and GE Terminet terminals are GFE and repairs are effected by spare replacement or vendor repair. The seven LMSC-furnished terminals are normally serviced by our technician or, if necessary, returned to vendor for repair.

There were 28 trouble reports opened during the one year operation, all of which are now closed. For 26 terminals, it required approximately 1 hour to effect repair. Two terminals required longer periods. One required 24.5 hours (GE Terminet) to secure vendor services. Another (TI) required 14.0 hours involving transporting unit to Phoenix for repairs.

A.2 QRS ROTATABLE ANTENNA

The QRS rotatable antenna assembly failed January 16 during alignment procedures. Investigation revealed high winds had loosened bolts that secured the motor/gear assembly. This caused the positioner to move several degrees, which sheared the screws fastening the worm gear assembly to the bearing shaft. This resulted in complete rotation freedom of the antenna. A detailed evaluation of the cause of failure resulted in a recommendation to remove the assembly and effect a thorough overhaul. A boom assembly for removing and replacing the rotatable antenna and positioner was fabricated and installed on the tower. High shear tolerance 1/4-inch screws using lock washers and Locktite were installed in place of the sheared screws. The sprocket pins were relocated in the worm-gear assembly away from the bolt head to ensure non-interference. New roll pins were installed using Locktite. Safety wires were used at the head of the cap bolts to prevent loosening of the bolts that secure the worm/drive assembly. All changes were designed to improve the structural integrity of the assembly and prevent a recurrence of the failure. The antenna positioner has been working successfully for 5 months during which time it was subjected to high (70 mph) gusty winds.

A.3 WIND-DRIVEN GENERATOR

The wind-driven generator (WDG) experienced initial start-up problems with the failure of the electronic control section and had to be removed and repaired during November. The diesel generator performed its function, although it was hard-wired into the station without controls. The sun sensor controls were installed on Nov. 16th and maintained automatic control through November 23, when the WDG was brought back on-line.

The WDG operated very well during December except for a minor problem in the system transfer assembly which required replacement of a new diode and filter capacitor. The WDG continued successful operation through January; however, on the morning of Jan. 28, 1976, the telemetry signal from QRS indicated a diesel generator start-up at approximately 0730. Further review showed that the diesel generator had started the previous day at 1700 hours and shut down at approximately 1830 hours. Investigation revealed that the WDG was missing 75 percent of one of its propeller blades, the tail assembly was off, and the generator casing was cracked in two places. A combined review by NASA/LMSC revealed that the blade suffered a structural failure, thus precipitating subsequent equipment failure. Work was initiated to correct the design efficiency; in particular, new blades were retrofitted to improve structural strength. The wind driven generator parts acquisition and repair required 2 months. The diesel generator has operated as the primary power very successfully, while the propane back-up generator has been utilized only during diesel refueling operations.

Appendix B

EVALUATION PLAN

The STARPAHC Evaluation Plan has been structured to provide data and information toward achieving these goals:

- o STARPAHC Improvement
- o Exportability *
- o Acquisition of Space System Design Data

B.1 DATA COMPILATION

Figure B-1 illustrates the hardware evaluation approach. Acquisition of field data is accomplished through the individual site personnel daily records (system operator -- telecommunications records; computer operator -- software/hardware; maintenance technician -- daily maintenance/logistic records; site manager -- summary records and IHS daily operation records). Data from these records is entered into computer-based or manual logs. These log entries are periodically cross-checked and correlated with the IHS medical evaluation data compilations. There are four computer-based logs and two manual logs which, with their data and format, are described in Table B-1.

B.2 ANALYTICAL PROCESS

Raw data in each of the four computer-based logs is reduced to a summary print-out giving pertinent data as indicated in Fig. B-1. For example, a report program for the equipment usage log produces total telecommunication transmission by facility, by type of TCE, and lists the quality and purpose of each transmission. Similarly, the Equipment Trouble Reports are summarized on a monthly basis, per specific components or in any format that lends itself to trend analyses or comparative analyses.

* Potential for use in other areas.

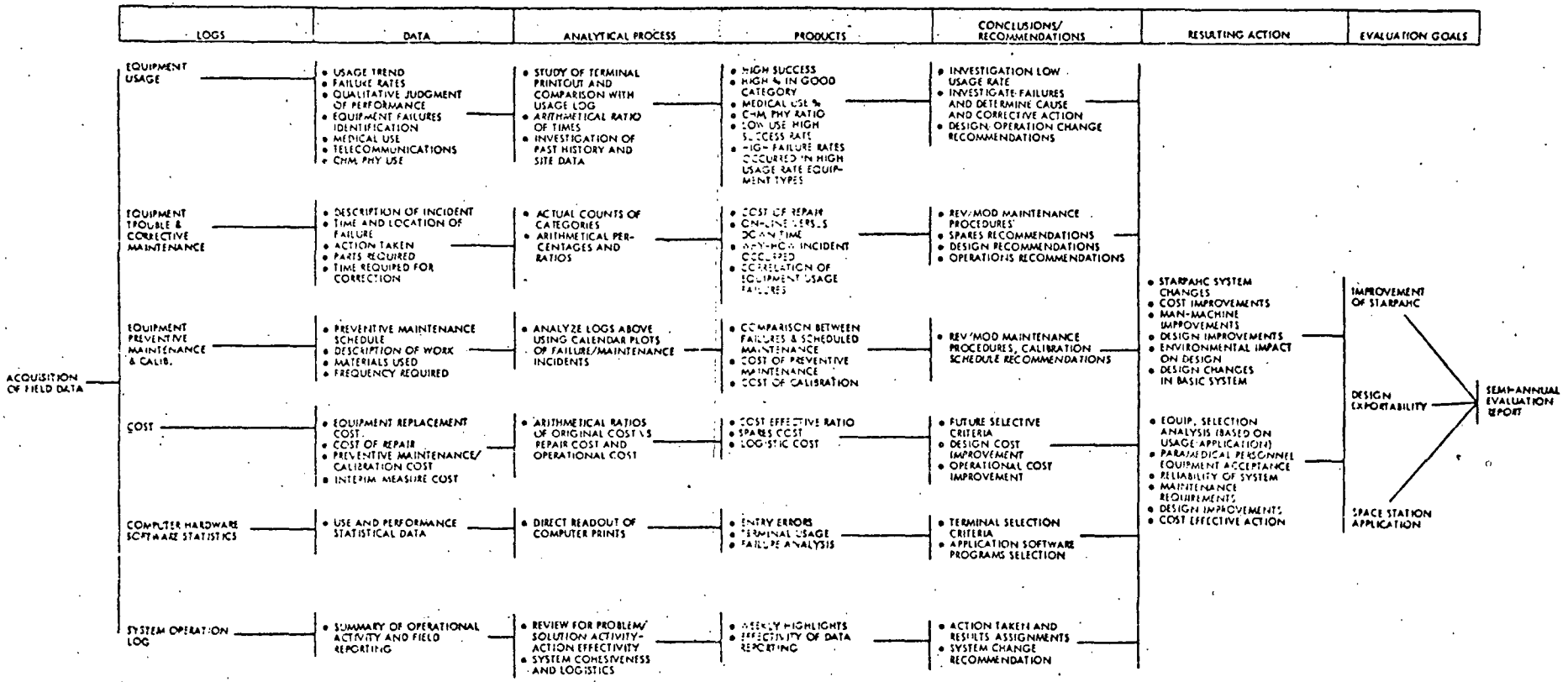

Fig. B-1 Hardware Evaluation Approach

Table B-1

DATA LOGS

- Equipment Usage Log

  The Usage Log identifies Date the equipment was used, Equipment Name, Purpose for the telecommunication, Quality, and Location to Location of the transmission.

- Equipment Trouble and Corrective Maintenance Report

  The Trouble Report identifies Date, Hour, Equipment, Facility, Model, Location, Serial Number, When Observed, and Action Taken. Also, this report indicates parts required and a complete description of the incident. Time back on line and date is also indicated.

- Equipment Preventive Maintenance and Calibration Log

  This report indicates Date, Hour, Equipment Name, Facility, Equipment Type, Manufacturer, Model, Serial Number, Location, and Description of work to be done. This report is very narrative and gives the technician a clear work schedule and exactly what manuals (if any) to use and the frequency and materials required to do any given maintenance.

- Computer System Statistics

  The Computer Log provides User's Name, Tool Name, Terminal Used, Data Base Number, Number of Inputs from Terminal, and Number of Outputs to Terminal.

- Manual Cost Log

  The Cost Log per se indicates only the original cost of each piece of equipment in the system by equipment types. Cost sources are varied and cover the spectrum of time charge monitoring of Lockheed site personnel to separation of cost as a result of petty cash expenditures. Only direct costs associated with the hardware will be reported.

Brief computer printouts of three computer-based logs follow.

Equipment Usage Log Computer Printout

Periodically, the data from the hand-written log is entered in the evaluation data base within the Varian mini-computer. The hard-copy log is retained as backup for the computer data. A typical example of an equipment usage log computer printout is as follows:

DATE	EQUIPMENT TYPE	PURPOSE	QUALITY	TOTA	LOCAT	LOCAT
01DEC75	VHF	COMMUNICAT	GOOD	.1	MHU	HSSCC
01DEC75	TELEMETRY (ORS)	CONTROL	GOOD	.1	HSSCC	ORS
01DEC75	HOTLINE	COMMUNICAT	GOOD	.1	MHU	HSSCC
01DEC75	COLOR TV, PATIE	CHECK OUT	GOOD	.1	MHU	HSSCC
01DEC75	COLOR TV, LAB M	CHECK OUT	GOOD	1.2	MHU	HSSCC
01DEC75	VHF	COMMUNICAT	GOOD	.1	HSSCC	ORS
01DEC75	ORDERWIRE	COMMUNICAT	GOOD	.1	ORS	HSSCC

Table B-1 (Continued)

Equipment Trouble Report Log Computer Printout

This Log is entered as soon as it is reported and remains open until fixed. A brief extract of the computer printout is shown below:

```
DATE:03DEC75
HOUR:0930
EQUIPMENT NAME:MAIN GEN
FACILITY:MHU
FORM NAME: TROUBLE REPORT #1
MODEL:                              30EK-3R
LOCATION:                           MG/A01
SERIAL NO.:
PREPARER:                           P.A.RUIZ
OBSERVED DURING:                    OPERATIONS
INCIDENT CLASS:                     FAILURE
ACTION TAKEN:                       REPLACED HIGH TENSION WIRE BETWEEN -
                                    COIL AND DISTRIBUTOR. *16DEC75*

PARTS REQUIRED:                     1FT HIGH TENSION WIRES *16DEC75*
TIME FOR CORRECTION:                .5 HRS *16DEC75*
DESCRIBE INCIDENT:                  WIRE TO COIL OF DISTRIBUTOR BROKEN.-
                                                IMMEDIATE ACTION:TEMP. F-
                                    IX WITH TAPE.
DATE BACK ON LINE:                  16DEC75 *16DEC75*
TIME BACK ON LINE:                  1000 *16DEC75*
T.R. SERIAL NO:                     302
```

Preventive Maintenance Instructions Log Computer Printout

The Preventive Maintenance Instructions (PMI) supports the Trouble and Corrective Maintenance report for further evaluation as to "why" and "how" the problem occurred and what future action needs to be taken to prevent a reoccurrence.

```
DATE:01DEC75
HOUR:0003
EQUIPMENT NAME:AUDIO/INST. RECORDER
FACILITY:HSSCC
FORM NAME: PM REPORT #1
MANUFACTURER:                       H.P.
MODEL:                              3960F-005
SERIAL NUMBER:                      2116
LOCATION:                           H02/A14
MATERIALS USED:                     HEAD CLEANER & COTTON SWABS
TOTAL TIME:                         (.2)
```

The reduced raw data are next subjected to an analytical process that yields products such as arithmetical ratio, usage trends, performance acceptability ratios, transmission usage time, monthly comparison, and frequency/distribution of equipment usage. Two of the analytical processes are concerned with (1) anomalies (any measurement/data that deviates from normal performance -- fair, poor, not acceptable quality ratings) and (2) cost. The cost analysis collects capital equipment and operational costs and then relates the data to the system and medical usage time and to the number of patients treated. This affords a measurement of the effectiveness of the system.

The products of the analytical process as shown in Figure B-1 furnish the basis for conclusions and recommendations.

Resulting actions, as indicated in Figure B-1, are directly associated with meeting the three evaluation goals. Specific system or design changes and cost improvements are typical of the resulting actions.

B.3 DATA AUDIT

Three methods of auditing the accuracy of the entries in the equipment usage log are (1) local surveillance, (2) surveillance during visits, and (3) review of computer printout correlated against the system manager log, the two system operator's daily written reports, and the maintenance technician daily report.

The site manager oversees and routinely checks the entries on a daily basis as part of his preparation of his daily system status report. Spot checking on accuracy of entries is done directly while observing daily occurrences.

LMSC Sunnyvale personnel, on periodic visits to the site, also directly observe entries and verify accuracy on a sampling basis. The most important surveillance is scrutiny of the daily tape printout. Because there are hourly communications with site personnel on a variety of items, status of conditions, troubles, and incidents are being discussed continually. Accuracy of the entries can be verified by cross-checking the source of information. Errors in entry have been detected and corrected by this means.

B.4 MEDICAL EVALUATION APPROACH

The purpose of this section is to provide a description of the procedures, data sources and methods utilized in the medical evaluation approach.

There are some differences between the medical usage statistics and the hardware usage statistics. This section will clarify the reasons for these differences.

The primary reason for the apparent difference lies in the different approaches taken by the evaluation studies. The medical evaluation analyzes the use of the STARPAHC equipment from the viewpoint of the impact upon patient care, whereas the hardware evaluation assesses the performance and use of equipment types.

One tool used in the medical evaluation is the analysis of each "patient episode" where telecommunications equipment has been used.

A patient episode is defined as the patient/provider contact in which telecommunication equipment is being utilized.

The hardware evaluation as discussed in previous sections, analyzes the use of each component of the telemedicine system. One parameter is the purpose of the use of each piece of communications equipment. Of the six purpose categories listed, two are related to patient services, i.e., Medical Administration and Clinical Consultation. The two patient service purposes are abbreviated as "MED/ADM" and "CHM/PHY", respectively.

The purpose for each transmission requested by the health care staff is logged by the console operator at the Sells Hospital (HSSCC). If the request is for medical records personnel to come to the physician's console room, then the purpose is always designated medical administration (MED/ADM). If the field request is for a telephone connection to another Sells office, such as the laboratory, medical records, or the pharmacy, then this purpose is also designated as MED/ADM. All requests for the Sells physicians are entered as a clinical consultation purpose (CHM/PHY).

The Sells system operator can usually ascertain the correct purpose except when the privacy switch is in operation. The operator has been instructed not to ask the health service staff for the purpose to avoid interruption of the dialogue. If a voice connection is utilized (i.e., hot line, hands-free MUX or VHF), by the system operator or the health care staff, to discuss problems unrelated to any individual patient, then the operator has been instructed to code the purpose as "communication". If the health staff has the time to send reference signals, then this calibration activity is coded as "check out".

B.5 DATA SOURCES USED FOR MEDICAL EVALUATION

Both the hardware and medical evaluation have one common source, the systems operator's logs. The medical evaluation uses the following additional sources.

B.5.1 The Telecommunication Evaluation Forms (Tables B-2 and B-3)

These forms are to be filled out by both the sender and the receiver immediately after each teleconsultation. The information requested on each form is slightly different but similar in most respects. These forms are completed only by the health care staff, and only for transmissions relative to individual patients. Evaluation forms are filled out even when transmissions are classified as "poor" or "not acceptable". The protocol has excused the health staff from completing these forms only when a voice transmission is requested via a telephone patch to a site other than the physician's console room. This exception was made at the request of the health staff to avoid the paper work. However, these transmissions are logged by the systems operator under the appropriate identification number for the patient. The other exception is when only patient data has been requested by the field staff from the STARPAHC computer at Sells.

In addition, each Sells consultant's form is stamped by a time clock at the beginning and the end of each television consultation. From this information, the time and cost by health service staff category may be calculated.

Table B-2

TELECONSULTATION EVALUATION FORM FOR SELLS CONSULTANTS

1) Patient ID #_____

2) Date_____

3) Provider Code of Consultant_____

4) Consultation with (Check One):
- ☐ 03 - Santa Rosa
- ☐ 77 - Ambulance
- ☐ 83 - MHU
- ☐ Px - PIMC
- ☐ 98 - Other

5) Reception - Indicate (✓) below, quality of transmission for each modality received during this consultation:

	Good	Fair	Poor
a. Color TV	[1]	[2]	[3]
b. Color Endoscope	[1]	[2]	[3]
c. Color Microscope	[1]	[2]	[3]
d. Black & White TV	[1]	[2]	[3]
e. Cardiostethoscope	[1]	[2]	[3]
f. Voice	[1]	[2]	[3]
g. Data	[1]	[2]	[3]
h. ECG	[1]	[2]	[3]
i. X-ray	[1]	[2]	[3]
j. Regular Telephone	[1]	[2]	[3]
k. Hotline	[1]	[2]	[3]
l. Video Tape Viewed	[1]	[2]	[3]
m. Other_____	[1]	[2]	[3]
n. Audio Tape Used	/1/	/2/	/3/

Save Video Tape: Yes ☐ No ☐

6) Transmission - Indicate (✓) below, each modality you wanted to use but were unable to transmit during this consultation and reason why:

	Too Diff. Or Time Consuming	Schedule Problem	Patient Refused	Equip. Failure	Equip. Not Available	Other - Specify
a. Black & White TV	[1]	[2]	[3]	[4]	[5]	6._____
b. Voice	[1]	[2]	[3]	[4]	[5]	6._____
c. Data	[1]	[2]	[3]	[4]	[5]	6._____
d. Video Tape	[1]	[2]	[3]	[4]	[5]	6._____
e. Regular Telephone	[1]	[2]	[3]	[4]	[5]	6._____
f. Hotline	[1]	[2]	[3]	[4]	[5]	6._____
g. Slow Scan TV	[1]	[2]	[3]	[4]	[5]	6._____
h. Other_____	[1]	[2]	[3]	[4]	[5]	6._____

7) Indicate (✓) your impression of the result of this teleconsultation (Indicate responses for items a - g):

	None	Some	Great
a. Confirmed or reassured first impression	[1]	[2]	[3]
b. Assessment of patient problems more definite	[1]	[2]	[3]
c. Change in treatment plan	[1]	[2]	[3]
d. Educational value to yourself	[1]	[2]	[3]
e. Education value to remote provider or patient	[1]	[2]	[3]

	No One	PHN	CHR	Sells	PIMC	Tucson	Other
f. Generated a referral to	[1]	[2]	[3]	[4]	[5]	[6]	[7]
g. Eliminated a referral to:	[1]	[2]	[3]	[4]	[5]	[6]	[7]

h. Other result or impact_____

8) In summary, this teleconsultation was (Check One):

- a. ☐ Critical for the proper care of this patient
- b. ☐ Important or useful
- c. ☐ Of little or no value
- d. ☐ Confusing or harmful

FORM SEA 775

Table B-3

TELECONSULTATION EVALUATION FORM FOR SANTA ROSA CLINIC AND MOBILE HEALTH UNIT

1) Patient ID # _____

2) Date _____

3) Provider Code _____

4) Consultation with (Check One):
- ☐ 01 - Sells
- ☐ 03 - Santa Rosa
- ☐ 83 - MHU
- ☐ Px - PIMC
- ☐ 98 - Other

5) Reception - Indicate (✓) below, quality of transmission for each modality received during this consultation:

	Good	Fair	Poor
a. Black & White TV	[1]	[2]	[3]
b. Voice	[1]	[2]	[3]
c. Data	[1]	[2]	[3]
d. Video Tape Viewed	[1]	[2]	[3]
e. Regular Telephone	[1]	[2]	[3]
f. Hotline	[1]	[2]	[3]
g. Other _____	[1]	[2]	[3]
h. Audio Tape Used	/1/	/2/	/3/

6) Transmission - Indicate (✓) below, each modality you wanted to use but were unable to transmit during this consultation and reason why:

	Too Diff. or Time Consuming	Schedule Problem	Patient Refused	Equip. Failure	Equip. Not Available	Other - Specify
a. Color TV	[1]	[2]	[3]	[4]	[5]	6. _____
b. Color Endoscope	[1]	[2]	[3]	[4]	[5]	6. _____
c. Color Microscope	[1]	[2]	[3]	[4]	[5]	6. _____
d. Black & White TV	[1]	[2]	[3]	[4]	[5]	6. _____
e. Cardiostethoscope	[1]	[2]	[3]	[4]	[5]	6. _____
f. Voice	[1]	[2]	[3]	[4]	[5]	6. _____
g. Data	[1]	[2]	[3]	[4]	[5]	6. _____
h. ECG	[1]	[2]	[3]	[4]	[5]	6. _____
i. X-ray	[1]	[2]	[3]	[4]	[5]	6. _____
j. Regular Telephone	[1]	[2]	[3]	[4]	[5]	6. _____
k. Hotline	[1]	[2]	[3]	[4]	[5]	6. _____
l. Other _____	[1]	[2]	[3]	[4]	[5]	6. _____

7) Reason for initiating teleconsult (Check One or More):

- a. ☐ For help in diagnosing or treating patient problem
- b. ☐ Patient request
- c. ☐ Educational
- d. ☐ By instruction or protocol
- e. ☐ Other reason - specify _____

8) Indicate (✓) your impression of the result of this teleconsultation (indicate responses for items a - f):

	None	Some	Great
a. Confirmed or reassured first impression	[1]	[2]	[3]
b. Assessment of patient problem more definite	[1]	[2]	[3]
c. Change in treatment plan	[1]	[2]	[3]
d. Education value to yourself.	[1]	[2]	[3]
e. Education value to patient	[1]	[2]	[3]

	No One	PHN	CHR	Sells	PIMC	Tucson	Other
f. Generated a referral to:	[1]	[2]	[3]	[4]	[5]	[6]	[7]
g. Eliminated a referral to:	[1]	[2]	[3]	[4]	[5]	[6]	[7]

h. Other result or impact _____

9) In summary, this teleconsultation was (Check One):

- a. ☐ Critical for the proper care of this patient
- b. ☐ Important or useful
- c. ☐ Of little or no value
- d. ☐ Confusing or harmful

FORM SEB 775

B.5.2 The Computer Printouts from the Health Information System (HIS) (Table B-4)

Each month, all patient visits to the mobile unit and to the Santa Rosa Health Clinic are received by the IHS evaluation office. The patient's name, identification number, health provider and health problems are included in this printout along with other information. This request is processed for each month at the end of the third week of the following month. This delay is for the purpose of including as many late patient encounter forms as possible and yet be able to produce a timely monthly report.

B.5.3 The Patient's Health Records (Table B-5)

The complete hard copy health record for each patient whose encounter involves a STARPAHC transmission is analyzed by the evaluation office. The purpose is to describe the results of the communication within the total context of the patient's problem. The time intervals between the steps in the process of health care, and the miles traveled by the patient are documented. (The process of health care includes the time and distance between the occurrence of the problem and the first contact with the health system, the time between first contact and symptomatic treatment, first impression and definitive diagnosis, definitive diagnosis and definitive treatment, and finally, time of resolution of the problem.)

The HIS system also provides narrative medical summaries for certain patients. Patient's records are selected for critical case review if a clinical consultation utilizing the STARPAHC television equipment occurred or if the consultation results are coded as either "critical for the proper care of the patient" or "confusing or harmful" in the opinion of the health staff.

B.5.4 Interviews with the Health Staff

The STARPAHC evaluator interviews all users of the system when there is difficulty in reconstructing a patient transmission selected for critical case review. These difficulties usually arise because of incomplete records or incongruous records.

Periodically structured interviews are conducted by a trained behavioral scientist with all the health staff. This is a separate study design and report. It has not been included in this evaluation report.

Table B-4

HIS MONTHLY PATIENT TABULATION

FACILITY: MOBIL HEALTH

**********CONFIDENTIAL MEDICAL INFORMATION********** 10/21/75

	IID	BIRTH DATE	SEX	HR NO.	ENCTR FAC	ENCTR DATE	O I	F R	P S	PROV	LCOA. STAGE	DIAGNOSIS
PATIENT'S NAME DELETED	001495	09/10/928	M		000183	09/02/75	O	1	2	11	01/0091-1	DIARRHEA I
	001495	09/10/928	M		000183	09/02/75	O	1	1	11	01/401 -	HYPERTENSION CHECK
	001495	09/10/928	M		000183	09/02/75	O	1	2	11	01/7873-	PAIN L HIP
	002278	07/04/927	F		000183	09/02/75	O	1	2	11	01/9160-	ABRASIONS L LEG
	002278	07/04/927	F		000183	09/02/75	O	1	1	11	01/401 -	HYPERTENSION CHECK
	004042	07/16/948	F		000183	09/02/75	O	1	1	05	01/0340-	TREATED FOR POS STREP THROAT
	004124	07/09/935	F		000183	09/02/75	O	2	1	11	01/5990-	F U, U T I
	004386	11/11/966	F		000183	09/02/75	O	1	1	11	01/380 -	BILATERAL OTITIS EXTERNA
	004386	11/11/966	F		000183	09/02/75	O	1	2	11	02/9000-	SCHEDULE I V P. U T I SURVEILLANCE
	004424	03/17/950	F		000183	09/02/75	O	2	1	11	01/465 -	U R I
	004424	03/17/950	F		000183	09/02/75	O	2	2	11	01/8479-	BACK STRAIN
	004843	01/11/965	F		000183	09/02/75	O	2	1	11	01/8930-	LACERATION TOE, R FOOT
	005180	08/28/948	M		000183	09/02/75	O	1	2	11	01/Y049-	G C CONTACT
	005180	08/28/948	M		000183	09/02/75	O	1	1	11	01/401 -	HYPERTENSION CHECK
	005773	03/19/938	M		000183	09/02/75	O	1	1	11	01/7855-	ABDOMINAL DISCOMFORT UNCERTAIN ETIOLOGY
	005902	02/05/953	F		000183	09/02/75	O	1	2	11	01/0049-	SUSPECT SHIGELLA
	005902	02/05/953	F		000183	09/02/75	O	1	1	11	01/401 -	HYPERTENSION CHECK
	013068	06/22/971	F		000183	09/02/75	O	2	1	11	01/9969-	F U TRAUMA, HEMATURIA
	014309	07/31/972	M		000183	09/02/75	O	2	1	11	01/684 -	IMPETIGO SCALP, IMPROVED
	016359	12/15/973	M		000183	09/02/75	O	1	1	11	01/Y005-	IMMUNIZATIONS. WELL CHILD EXAM
	001208	07/01/938	M		000133	09/03/75	O	2	1	11	01/8100-	F U FX R CLAVICLE
	002260	02/28/927	M		000183	09/03/75	O	2	1	11	01/2959-	SCHIZOPHRENIA. THORAZINE REFILL
	003018	08/13/954	F		000183	09/03/75	O	1	2	11	01/Y009-	GRAVINDEX NEGATIVE
	003018	08/13/954	F		000183	09/03/75	O	1	1	11	01/465 -	U R I
	003361	12/25/955	F		000183	09/03/75	O	2	1	11	01/Y060-	PRENATAL
	003365	05/13/965	F		000183	09/03/75	O	1	1	11	01/7099-	LESION R 3RD FINGER
PATIENT' NAME DELETED	003405	03/15/942	F		000183	09/03/75	O	2	1	11	01/Y060-	PRENATAL

**********CONFIDENTIAL MEDICAL INFORMATION********** 10/21/75

TABLE B-5

HEALTH SUMMARY FROM THE HEALTH INFORMATION SYSTEM

♦♦♦♦CONFIDENTIAL PATIENT DATA♦♦♦♦

HEALTH SUMMARY
(06/04/76)

NAME: DOE-000001 ,JANE PMID
LITTLE TUCSON AZ
SEX: FEMALE
BIRTH: 07/01/1927
MOTHER: MOM-LAST ,MOM-FIRST MMID
SSN: 526-47-5634
INT ID: 6-000001
REGISTER NOS:
HYPER REG 00-01-HY-002869
R.F. REG 00-01-RF-002869
H.R. NOS:
SELLS 00-01-01-006688
S.X. 00-01-02-010278
S.R. 00-01-03-001934
PISINEMO 00-01-04-000960

MEASUREMENTS

DATE	WT	PCT	HT	PCT	BLD PRS	HD CIRC
04/08/76	187-08				140/100	
01/06/76					134/080	
12/03/75	180-00				130/100	
10/17/75	176-08		64		100/080	

VISION

			UNCORR	CORR
03/21/75	SELLS	L	20/050	
		R	20/050	

♦♦♦♦CONFIDENTIAL PATIENT DATA♦♦♦♦

ACTIVE PROBLEMS

025	04/11/75	034	SELLS	ANTICOAGULATION
004	03/04/69	097	PISINEMO	DIABETES MELLITUS
016	03/11/69	024	SELLS	OBESITY EXOGENOUS
027	07/29/75	034	SELLS	PERIPHERAL NEUROPATHY

TABLE B-5 CONTINUED

INACTIVE PROBLEMS

015	03/13/74	030 SELLS	ANXIETY REACTIONS
007	02/28/73	025 SELLS	OTITIS MEDIA SUPPURATIVE CHRONIC PSEUDOMONA
023	07/29/75	034 PISINEMO	R OTITIS MEDIA
022	07/29/75	034 PISINEMO	STASIS ULCER L LEG

ACTIVE MEDICATIONS

04/20/76	DIGOXIN	1 TAB 250 MCG	1 TIME /DAY	030
04/14/76	HYDROCHLOROTHIAZIDE	1 TAB 50 MG	1 TIME /DAY	030
04/14/76	K-LYTE	1 TAB 25MEQ K	2 TIMES/DAY	060
04/14/76	ACETOHEXAMIDE	1 TAB 500 MG	3 TIMES/DAY	090
04/08/76	BACITRACIN	9 OINT 500U/GM	1 TIME /DAY	015
04/08/76	DETERGENT, SURGICAL	9 SOLN 3 PCT	1 TIME /DAY	300

◆◆◆◆CONFIDENTIAL PATIENT DATA◆◆◆◆

INPATIENT ENCOUNTERS

10/15	10/17/75 SELLS	GASTROENTERITIS, SHIGELLA ISOLATED DIABETES MELLITUS. MEDICATION NONCOMPLIANCE RHEUMATIC HEART DISEASE
10/14	10/15/75 CHS OTHER	A S H D WITH TACHYCARDIA, ATRIAL FIBRILLATIO
08/07	08/12/75 SELLS	UTERINE MYOMA DIABETES MELLITUS MITRAL STENOSIS. CONGESTIVE HEART FAILURE MEDICATION OVERDOSE.DIGOXIN,COUMADIN,DYMELOR
04/07	04/11/75 SELLS	MITRAL STENOSIS,ATRIAL FIBRILLATION.ANTICOAG

OUTPATIENT AND FIELD ACTIVITIES

04/20/76	MD	SELLS	2 MITRAL STENOSIS G III F C
04/14/76	MD	SELLS	2 MED REFILL
04/08/76	CHM	SELLS	1 PUNCTURE WOUNDS L LOWER LEG
03/16/76	LPN	MHU	2 R F PROPHYLAXIS
03/10/76	DCP	HOME	2 RHEUMATIC FEVER F U
03/01/76	DCP	HOME	2 RHEUMATIC FEVER
01/20/76	MD	SELLS	2 MITRAL STENOSIS,ATRIAL FIBRIL,FUNCT II,III
01/20/76	DCP	OTHER	2 PT TRANSPORTED FOR CARDIAC CLINIC
01/16/76	DCP	HOME	2 WELL PATIENT VISIT
01/15/76	PHN	HOME	2 DIABETIC

TABLE B-5 CONTINUED

```
SCHEDULED - ENCOUNTERS

IMMUNIZATIONS

 SMALLPOX  B 11/18/64
 DT        3 10/07/64
 SABIN TRI 3 12/02/64
 INFLUENZA 2 01/02/74
 INFLUENZA   12/12/73

                                    ****CONFIDENTIAL PATIENT DATA****

SKIN TESTS

 TINE       12/29/71
 PPD        04/11/75 N 00
 PPD        09/07/73 N 00
 PPD        05/05/70 N

LAB/X-RAY RESULTS

          04/20/76 03/12/76 01/20/76 01/06/76 12/19/75 12/03/75 10/15/75
FBS                                                      390.      284.
POTASSIUM                                                            4.2

SPECIAL SURVEILLANCE
      HYPERTENSION
         PATIENT IS HYPERTENSIVE CHECK BLOOD
         PRESSURE, WEIGHT + COMPLIANCE WITH PLAN
        *05/14/76  DUE FOR MED REFILL

REGULAR SURVEILLANCE STATUS

              LAST      NEXT

*DT         10/07/64   DUE NOW

*CDCCI                 DUE NOW


 CH X-RAY   04/20/76   04/20/77
*PAP        01/22/75   DUE NOW

*BREAST     04/11/75   DUE NOW
 HEART      08/20/75   08/20/76
 RECTAL     07/02/73   07/02/76

****END****                         ****CONFIDENTIAL PATIENT DATA****
```

B.5.5 Data Source Common to Both Evaluations (Table B-1)

Both studies utilize a computer printout titled "Equipment Usage Log". The program is constructed from the console operator's logs. It includes the date, type of equipment used, locations involved in the transmission, purpose of the use, and the quality of the signal as estimated by the operator.

In one respect, the printout for the hardware evaluation differs from the printout for the medical evaluation. The hardware evaluation form contains the time in minutes that each component was in use. The retrieval report used for medical evaluation contains the patient's identification number for each use of each piece of communications equipment instead of the elapsed time.

B.6 PROCEDURES FOR ANALYSIS OF UTILIZATION REPORTS

At the end of each month, the telecommunication evaluation forms from the IHS staff are received by the STARPAHC evaluator.

The computer printout from the equipment usage logs maintained by the Sells systems operator is also received. Comparisons are then made, and a list of patient transmission discrepancies is generated and sent to the system operator. The operator then consults the daily hand-written logs for those transmissions reported by IHS, but not indicated on the equipment usage log printout. The missing patient consults are entered into the computer if they can be located in the daily log and matched to the patient's identification number. However, the tables prepared by the IHS evaluator for the monthly reports include all known patient transmissions whether or not they were recorded by the systems operator.

Transmissions known to the systems operators, but for which the IHS staff failed to return evaluation forms, are included in the tables reporting the ratio of use, by site and purpose, and whether voice or television was used. Charts are then located for clinical use of television (as reported by the systems operators) and analyzed for impact whether or not IHS evaluation forms are available.

Occasionally, the printout indicates that a clinical transmission occurred using certain communications equipment but the operator failed to indicate the patient's identification number. If an IHS evaluation form with an identification number is available for these transmissions, then both the hardware and medical reports will include this information, and the printout will be corrected. If no information is available to relate the transmission to an identifiable patient, then this consult will not be tallied in the IHS report. However, the hardware report will include in the totals the fact that specific items of equipment were used for clinical or administrative purposes.

The following example using a portion of the equipment usage printout should clarify the above procedure:

05May75	x	TEL-CPLR	MED/ADMIN.	GOOD	HSSCC	MHU
05May75	x	HANDSFREE, MUX	MED/ADMIN.	GOOD	MHU	HSSCC
05May75	x	HOTLINE	COMMUNICAT	GOOD	MHU	HSSCC
05May75	x	HANDSFREE, MUX	MED/ADMIN.	GOOD	MHU	HSSCC
05May75	x	HOTLINE	COMMUNICAT	GOOD	MHU	HSSCC
05May75	x	HANDSFREE, MUX	MED/ADMIN.	GOOD	MHU	HSSCC

This use of equipment occurred on May 5, between the mobile unit and the Sells hospital. In the column where the patient's number should appear, an "x" is seen instead. The purposes were indicated by the systems operator as "medical administration" and as "communication" referrable to a patient.

In order to avoid losing potentially valuable data, it was agreed that the hardware tally should include these data. However, it is impossible for the IHS evaluator to decide from this data alone whether one or six patient episodes occurred. Therefore, this information is omitted from the IHS report. Every effort is made to find the missing patient numbers from the IHS evaluation reports and correct the printout.

The totals of specific pieces of equipment used in medical transmissions in the hardware reports cannot be equal to the total of patient episodes. One patient episode could potentially account for the use of from one to twenty-two different components of STARPAHC communications equipment to complete the consultation. (The list of equipment used in the hardware evaluation does not include any computer components, nor any non-communication equipment utilization such as microscopes, X-ray machine, incubators, etc.). Few, if any, episodes used more than 8 components.

B.7 PROCEDURES FOR ANALYSIS OF PATIENT VISITS

The tally of patient visits to the mobile and fixed clinics is provided by the Health Information System printout. The information on this printout includes ID and district of residence of the patient.

The IHS evaluator requests this printout three weeks after the end of the previous month for monthly reports, and eight weeks after the end of the quarter for quarterly reports. This delay is necessary so that patient encounter forms that are delayed for being entered into the computer can be counted.

Only those "encounters" forms that relate to an actual visit to a site for health services are counted in this printout.

Each IHS evaluation form (as discussed under B.5.1) recording a STARPAHC transmission and a patient number is checked against this evidence of a patient encounter as listed in the HIS printout. The quarterly listing of all diseases and patient problems for which the STARPAHC equipment was utilized is prepared after correlation and corrections have been made.

Patient encounter forms are utilized by the health staff for many purposes other than to record an actual patient visit. Some of these purposes are to keep the computerized medical summary up to date by recording information obtained before or after the actual patient visits; to record medication renewals given to a patient attending a clinic but intended for another patient not in attendance; to schedule appointments for patients not in attendance; and many other purposes. These encounters are not totaled as patient visits in the IHS monthly evaluation reports. They are included under the category of "Other Patient Services" in the IHS quarterly reports.

On the other hand, many patients visit facilities in person and no encounter forms are generated. These visits may be for the purposes of: Bringing a specimen for a laboratory test that was requested during a formerly recorded encounter, to make an appointment for themselves or someone else, to bring letters or other documents requested by health providers, and many other reasons. On rare occasions, the provider fails to complete the encounter form, or the form fails to reach the keypunch operator in Tucson.

In addition to obtaining the number of patient visits from the HIS printout, the medical evaluation reports also include the total patient "problems" that are listed for each visit. Some "problems" as written by the health provider are actually reasons for the visit rather than health problems such as "immunizations", "well child exam".

The total of patient visits, and the total patients' problems are used to calculate two different ratios for equipment utilization in the STARPAHC project.

B.8 LIST OF MEDICAL TABLES AND CORRELATIONS TO BE COMPILED MONTHLY IN THE EVALUATION REPORTS

1. Frequency of use by site and type of communication (voice or television).
2. Patient utilization by day for two CHM sites equipped with telecommunications (Mobile Clinic and Fixed Health Center).
3. Frequency of use of STARPAHC communications equipment by health provider category and site.
4. The reason for initiating telecommunications by site.
5. The type of impact from the completion of the telecommunication by degree.
6. The value of each telecommunication by type of health provider.
7. Frequency of failure to complete a desired telecommunication by type of equipment and reason.
8. Correlation table of patient episodes where telecommunications were used by data source (IHS or LMSC) and reason for use.
9. Summary of each patient episode where television was used for clinical consultation.
10. Summary of each patient episode valued by IHS staff as being "critical for the proper care of the patient" or "confusing or harmful".
11. Telecommunications ratio of use by number of patient visits and number of recognized patient problems.

APPENDIX C

STARPAHC SYSTEM DESCRIPTION*

STARPAHC combines basic health care facilities, and supporting technical services into a health care delivery system. The STARPAHC operational concept is based on utilizing the professional IHS staff of the Sells Hospital, where the HSSCC is located, to provide direction and consultation to paramedical and technical personnel stationed at the remote clinics, LHSC, and the MHU. The interchange of information between the HSSCC, LHSC, and MHU is accomplished by voice, data, and video communication links. Computer-based data management techniques implements record keeping, data retrieval and data analysis.

The STARPAHC elements are operated by a team consisting of IHS-provided physicians and health-care professionals and by LMSC-provided technical personnel. Remote health-care professionals are under the direct supervision of an IHS physician at Sells by means of voice, data, and video communication channels between the STARPAHC elements interconnected by the relay station on Quijotoa (as depicted in Figure C-1). The configuration as shown in Figure C-1 consists of:

- The control center, located in one wing of the Sells Hospital. It is staffed by IHS physicians and LMSC Telemedicine system operators.
- A local health service center at the Santa Rosa Clinic. It is staffed by IHS CHM's and functions as a fixed remote clinic.
- A mobile health unit. This is a clinically equipped van-type vehicle that is staffed by an IHS CHM and an IHS laboratory technician. It functions as a remote mobile clinic, visiting a number of villages on a preselected route and schedule.
- The Phoenix Referral Center. This facility provides a Telemedicine room in the Indian Health Service Hospital in Phoenix for access to specialists (through audio and slo-scan television links) from the control center.

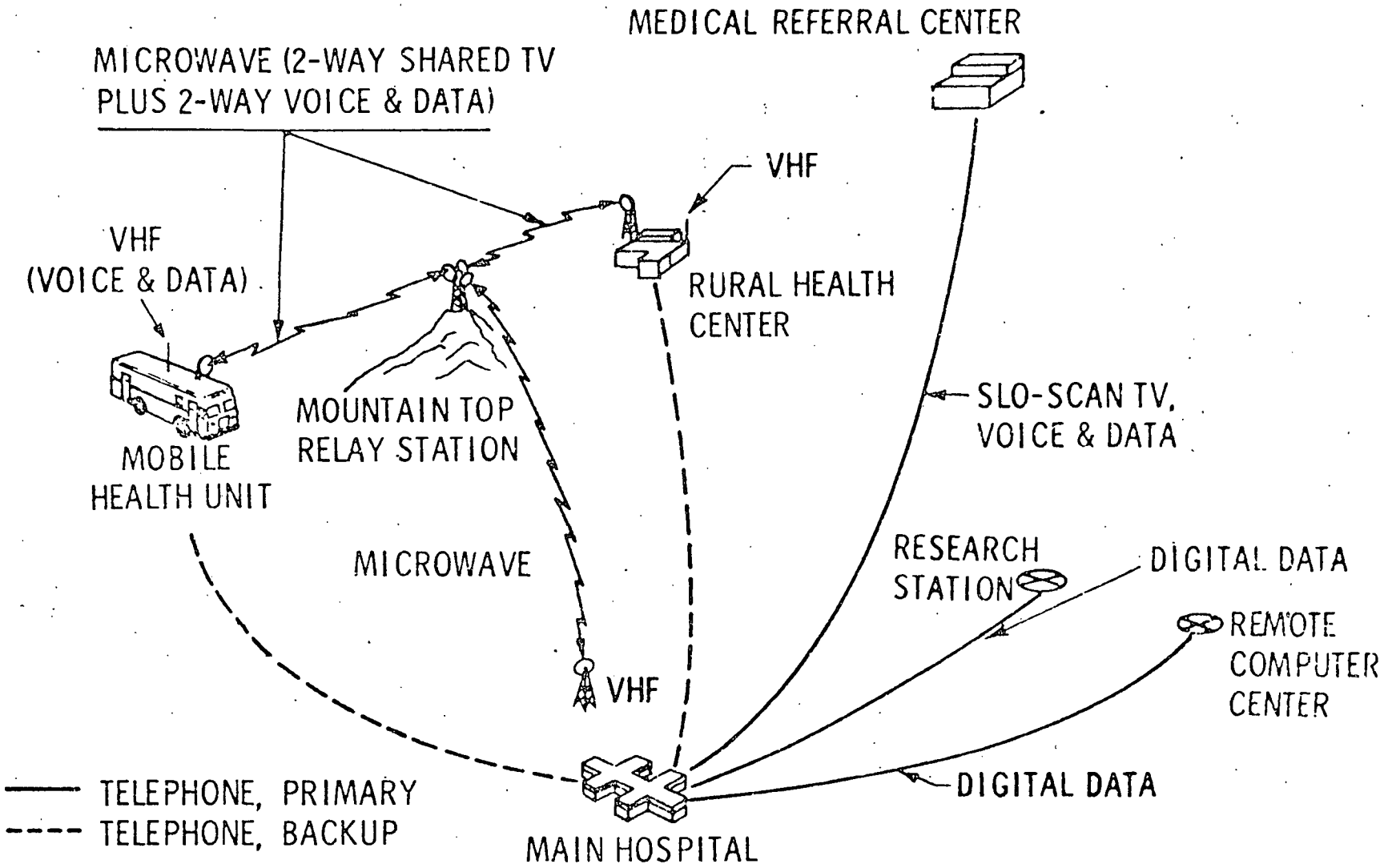

Fig. C-1 STARPAHC System

- The Tucson Computer Center. This facility provides STARPAHC data system access to the Indian Health Service patient information system data base.
- The Quijotoa Relay Station. This station is used for microwave transmission of television, voice, and data and VHF voice/data between major system elements.

C.1 HSSCC

The Indian Hospital at Sells, Arizona contains the Control Center of the system. Here, the physician directs the community health medics and laboratory technicians, communicates with patients, and calls up data to assist in the examination and treatment of patients.

The physician can also consult with specialists at the Phoenix Indian Health Hospital and can direct the system operator to perform specific functions such as recording a TV image, sending slo-scan TV X-ray images to Phoenix, and selecting other needed communications modes.

The nerve center of the STARPAHC communications system is contained in the Operator/Communication room at Sells. From the operator's console, the system operator interconnects all video, voice, and data links in the system by means of the equipment in the room. Communication outputs and inputs are provided in three separate modes: microwave (video, voice, data): VHF radio (voice, data); and telephone (voice, data, single-phased recorded video).

The Data Equipment Room at Sells contains the computer system and data bank and peripheral data equipment. STARPAHC data is fed into the computer from LHSC, MHU and other remote location video display, teletypewriter, and printer sources. This information is stored in the data base for playback to all sources or to the Tucson Computer Center (TCC). Information at the TCC can also be received and routed to STARPAHC locations by the Sells computer.

The Physician's Room at Sells contains equipment and apparatus allowing the physician to view, hear, and direct medical activities at the MHU and the LHSC, to communicate visually or by voice with all other elements of the STARPAHC system; to ask for an receive computerized patient's records and other data; and to have consultation with other physicians at the PRC. The Physician carries out these activities with a minimum of controls from his desk at the Physician's Console. In addition to the Console, he has at his disposal, a 3-channel ECG cart with cardioscope/strip chart recorder, and a B&W TV camera and X-ray film viewer. A dedicated B&W TV camera is housed in his console to provide his image to the patient at the MHU and LHSC. All of this equipment can be operated by the physician while seated at the console.

The HSSCC provides space for a VHF radio controller to enable communications with the existing IHS ambulance radio frequency. An area and interface capability is also provided at the HSSCC for a base station for communication with a Portable Ambulance Module (PAM) installed in an IHS Ambulance Van.

Interface between the HSSCC and the Tucson Computer Center is by high-speed serial-digital signals via telephone lines.

C.2 LHSC

The Santa Rosa Clinic is an existing clinic whose capabilities are enhanced by the telecommunication equipment provided by the STARPAHC system. The clinic is well equipped and staffed by paramedical personnel, laboratory technicians, and a secretary/receptionist. It provides the physician at the hospital control center with an "outreach" capability to deliver quality health care to patients through the STARPAHC system. There are three rooms in the clinic used for STARPAHC applications.

The Emergency Room at the Santa Rosa Clinic contains the STARPAHC operational console which is the central controlling unit for all of the clinic's STARPAHC equipment. The console controls the transmission and reception of visual and audio signals to and from Sells Hospital from several rooms including the Emergency Room. It also contains the individual controls that operate the two TV cameras and the intercom. One camera is used for patient viewing while

the other is used for endoscopic examinations. A video data terminal is located in the room to receive, send, and display information to and from the HSSCC computer.

The Examination Room, like the Emergency Room, has an intercom system and a video data terminal (identical to the emergency room's unit), a B&W camera and monitor is located in the room that can be used for sending X-ray images or any other visual data and can also be used for patient monitoring.

The Laboratory at the Santa Rosa Clinic has intercom units, a color TV camera matched to a standard binocular microscope, and a color monitor for viewing the transmitted slide image.

The Data Management area is a small room outside of the main entrance to the clinic. The room contains the two equipment rack assemblies that power and control all of the television, voice, and data communications equipment. The room is air conditioned to provide cool operating temperatures for the equipment, and comfort for maintenance personnel. A room-to-room intercom is provided.

A 55 KW Auxiliary Generator is permanently mounted on a concrete foundation outside the rear of the LHSC. This generator provides emergency electric power to the clinic and all electric equipment in the event of a failure of the regular power supply.

C.3 Mobile Health Unit (MHU)

The MHU is a smaller version of the Santa Rosa Clinic. It serves rural populations by scheduled visits to four Papago villages Monday through Thursday. Friday and Saturday are used for clean-up, maintenance, and repair. Overall vehicle specifications are:

Overhead Clearance	16 ft
Vehicle Width	8 ft
Vehicle Length	35.6 ft
Vehicle Length with Trailer	51 ft
Maximum Permissible Speed	45 mph
Fuel Capacity	60 gal

The MHU has four areas: 1) Cab, 2) Examination Room, 3) Reception/Communication/Lab Room, and 4) X-Ray Room. A 30 KW generator is mounted on a trailer which is towed behind the MHU.

The MHU has a number of two-way communication devices, both audio and visual, to permit full coverage of all situations between the MHU and Sells Hospital. The MHU roof antenna allows microwave TV and voice transmission from and to HSSCC via the Quijotoa Relay Station. VHF capability between LHSC and HSSCC is also available. Teletype and data equipment, both visual and printout, are provided for data input and retrieval, and the equipment is connected into computers serving the system. Inside the van, a room-to-room intercom is provided. When the van is unattended, an outside VHF handset can be used for emergency calls to Sells, and an alarm system will automatically sound an alert at Sells in case of fire, break-in, or an emergency call.

Most of the communications equipment in the MHU is controlled by or through the control panels located in each of these rooms. A hotline RF telephone is wall-mounted in both the Examination and the Reception Rooms which allows private talks with the HSSCC physician or operator.

Color TV monitors are provided in the Examination Room and the Laboratory area for monitoring transmitted images or for monitoring the transmitted Sells physician image. A B&W monitor is used in the X-ray room to view the transmitted X-ray images. Color TV cameras are used to send color pictures of the patient to the physician's console at Sells. One camera is used for standard patient viewing while the other is used for endoscopic examinations. A color TV camera combined with a microscope is located in the laboratory area for transmission of microscopic slide images.

A teleprinter is used in the reception area for sending or retrieving printed patient's records and other information. A CRT data terminal is located in the examination room which performs a similar function.

C.4 QRS

The QRS is located on the Quijotoa range which is approximately 3800 feet high. A good access road is available that is easily negotiated by a 4-wheel vehicle. The QRS provides a central location covering 350 degrees of coverage over the Papago Indian Reservation. There are three dual-feed dish antennas mounted on a 30-ft tower. They are dedicated to the HSSCC, LHSC, and MHU. The MHU antenna positioner can be rotated through 350 degrees covering all village stops presently scheduled and is capable of extending village coverage if needed. There is an 8' x 8' air conditioned shelter housing the communication equipment, battery charger, and batteries. A 2.5 KW wind generator provides primary power and a 6 KW diesel generator provides backup power.

C.4 PRC

The Indian Health Hospital at Phoenix, Arizona, which is referred to as The Phoenix Referral Center, is staffed with and has access to medical specialists. In the STARPAHC system these specialists will be called upon to consult with the physicians at the HSSCC when unique or complex medical advice is in order. To enhance the consultation, the system provides the capability for transmitting x-rays or pictures of the patient, lesions, etc., via slow-scan TV using existing telephone lines. These same telephone lines also provide capability for voice communication and data transmission between the HSSCC and the PRC. The slow-scan capability provides x-rays or picture transmission in two minutes. It inherently records the transmission which enables almost unlimited playback capability for extensive, repetitive studying at different times and for various durations.

APPENDIX D

AN EVALUATION OF THE MOBILE HEALTH UNIT SERVICE

The arrival times and service times of patients who used the Mobile Health Unit (MHU) of the Sells Service Unit were observed during the week of March 22-25, 1976. During this period, the unit was staffed by a driver, a nurse, and a medic.

The observer drove to Sells and then followed the MHU from Sells to Pisinimo, the village where clinic was to be held on Monday morning. The unit, pulling a trailer containing an electrical generator and portable stairs for the MHU, arrived at Pisinimo about 60 miles west of Sells around 9:15 A.M. The driver, with the help of some boys from the village, had one of the two sets of portable stairs in place by 9:30 A.M. The other set was not set up. The stairs and railings are heavy and while one person could handle them alone, it was much more efficient to have two or more people put them together. Between 9:30 A.M. and 9:38 A.M., the driver put up and adjusted the dish antenna which provides the microwave communication link between the MHU and Sells.

Although the clinic was not scheduled to begin until 10:00 A.M., two patients arrived early and were signed in by the driver at 9:40 A.M. The clinic nurse and the community health medic (CHM) arrived from Sells in separate vehicles. The nurse brought the driver's car so that he could use it to return home in the evening. (The driver lives in Santa Rosa.) The CHM drove the carry-all which is used to pick up patients and bring them to the MHU. Both the nurse and the CHM had some preparatory tasks (such as putting away supplies which were brought from Sells) to do before seeing patients. Patient screening by the nurse began at 10:18 A.M. Fourteen patients were seen before the half-hour lunch break, which was taken between 12:15 and 12:45 P.M. Ten patients were seen in the afternoon. Mean waiting and service times for each service point in the MHU are shown in Table 3-8. Patients wait outside the unit until paged by the nurse over the MHU PA system.

Normally, the driver takes the carry-all to San Lucy, a village several miles south of Pisinimo, on Monday mornings to pick up patients. However, on the Monday observed, he had to take an emergency patient to meet the ambulance from Sells. Possibly because the driver was not able to get to San Lucy until afternoon, only one patient was brought in to the clinic. She was picked up at her home about 12:47 P.M.; her sign-in time was 1:04 P.M. However, she did not answer when called by the nurse at 1:40 P.M. She was called again at 2:14 P.M. and was seen by the nurse and the medic. Returning to her house with the driver, she probably arrived around 3 P.M.

The clinic's last patient left at 3:22 P.M. The MHU was to remain in Pisinimo overnight. On Tuesday morning, the driver went from his home in Pisinimo, left his car there, and drove the mobile clinic to Gu Vo. When the nurse and the CHM passed through Pisinimo on Tuesday morning, the nurse transferred to the car and thus the two vehicles were moved to Gu Vo.

Three patients signed in before 10 A.M. at Gu Vo and at about 10:17 A.M., nine patients - all children from the school - arrived. When patients arrived in groups such as these, waiting times from sign-in until being called by the nurse increased. These children waited about an hour on the average.

The staff took a lunch break between 12:30 and 1 P.M., having seen 23 patients; 15 patients were seen in the afternoon. Three of the patients visited the MHU to have their prescriptions refilled by the CHM.

The last patient left Gu Vo at 3:18 P.M. The stairs and antenna were dismantled for travelling and the three vehicles were driven to Quijotoa where the MHU was refueled and left for the night. The nurse left the car here for the driver and returned to Sells in the carry-all with the CHM. The nurse left all laboratory samples collected during the clinic day at the laboratory at the hospital in the evening.

The MHU was moved from Quijotoa to Hickiwan early Wednesday morning. The car was driven by the nurse from Quijotoa to Hickiwan where several patients who had been brought in by a CHR (Community Health Representative) from Charco 27 were waiting. Eleven patients were seen in the morning, only four of whom were from Hickiwan village. The village of Hickiwan is fairly scattered and after the lunch break the driver took the carry-all out into the village where he picked up five patients. These people were picked up around 1 P.M. and returned to their homes around 2:30 P.M. The driver waited until all the patients had been seen before driving the group home; they left the clinic about 2:20 P.M. The last patient left the clinic at 2:39 P.M.

On Wednesday afternoon after the clinic closed, the staff drove the three vehicles to Kaka, the village where clinic would be held on Thursday. Then the nurse and the medic returned to Sells in the carry-all while the driver took his car to Santa Rosa.

On Thursday, when the CHM came through the village of Ventana on his way to Kaka, he picked up four patients on a circle of the village about 9:30 A.M. These patients were seen in the clinic and were taken home by the driver. They arrived home around 11:30 A.M. Some of the patients had to wait over an hour to go home because the last patient seen required about an hour of medic service which included an x-ray and fairly lengthy communication with Sells.

It is possible that the nursing service times on Thursday differ from those on the preceding three days because a substitute nurse was on duty. Other variations in service from location to location were the services of CHR's in the clinic on Tuesday and Wednesday. These people served as interpreters for the medic, who did not speak Papago.

The normal method of obtaining a patient's medical record information on the MHU is to retrieve a medical summary through the teletypewriter. The computer was not working on Tuesday and Wednesday, hence medical summaries could not be obtained.